EXAMINING THE FACTORS THAT MODERATE AND MEDIATE THE EFFECTS ON DEPRESSION DURING PREGNANCY AND POSTPARTUM

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ABSTRACT

Background

Antenatal depression is relatively a new area of study compared to postnatal depression and the depth and sophistication of this research is yet developing. For instance, very little is reported on the specific role of the risk factors as moderators and mediators to explain the variability in the magnitude of exposure and the causal pathway for depression during pregnancy. Moderators are those variables that are not modifiable (e.g., ethnicity, and gender), or have qualitative character or nominal in nature, and could also often be antecedent to other independent variables (e.g., behavioural and psychosocial) and depression. Mediators are those variables that may be better able to describe the pathway that connects a predictor to an outcome and intervention can be designed targeting mediators as they are causally related to the outcome. This thesis will address this gap in research and provide empirical evidence to increase the understanding of the role of each identified risk factors that could potentially influence maternal mental health interventions.

Methods

In this thesis, I have used the Feelings in Pregnancy and Motherhood (FIP) study. This was a longitudinal study and 649 pregnant women participated in the study. Women were interviewed three times over the course of their pregnancy and the immediate postpartum. Depression status was assessed by the Edinburgh Postnatal Depression Scale (EPDS);

sociodemographic characteristics, psychosocial and behavioural information were collected at each time point. Depression status in late pregnancy and postpartum were the two outcomes of interest. Non-modifiable sociodemographic risk factors were considered as moderators. Behavioural and psychosocial variables were considered as mediators. Moderators and mediators were tested through series of regression analysis.

Results

In modeling moderating effects in late pregnancy, low income women who were in poor marital relationships (β=1.54; $p<0.05$) and partnered women (married or common law) who reported having used recreational drugs (β= -1.62; $p<0.05$) were more likely to be depressed. Young mothers with low social support (β= 1.04; $p=0.15$) and Aboriginal mothers with low social support (β= 1.12; $p=0.17$) were also almost significantly noted to have depression symptoms in late pregnancy. In mediating analysis for late pregnancy, psychosocial mediators such as stress, social support, and marital satisfaction, and behavioural factors, such as smoking and recreational drug use exerted partial or full mediating effect for depressive symptoms in women in late pregnancy. In moderating analysis for postpartum, Aboriginal women who had never exercised in late pregnancy were found to be depressed at postpartum compared with non Aboriginal mothers who did not exercise. In looking at mediating effects in postpartum, smoking at late pregnancy exerted full mediating effects for ethnicity and marital satisfaction pathways, and partial mediating effects for age, education, and stress pathways in predicting depression in postpartum period among mothers.

Conclusion

Depression, particularly during pregnancy and in postpartum, is a top priority for women themselves, their families, care providers, and society in general. This study found that characteristics of women or their psychosocial or behavioural experiences could have specific effects such as either a mitigating or exacerbating role, or a mediating role, in depression in late pregnancy or in postpartum. This information could be strategically used by clinicians or by health promotion professionals to either target or provide tailored programs to women who might experience depression during pregnancy and postpartum.

DEDICATION

This work is dedicated to:

My parents, Kazi Mujibur Rahman and Nilofa Akhter; as they guided me throughout my life.

My wife, Jinnat Afsana; she supported me all the way long during my study.

And my son, Shayaan Kazi as he was my leisure time amusement.

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CHAPTER 1

INTRODUCTION AND OVERVIEW

Depression is one of the most common mental health problems worldwide. Approximately 450 million people are affected by mental and behavioural disorders worldwide and of these 350 million people suffer from depression.(1) Depression will be the second leading cause of disability worldwide by 2020.(1-3) Psychiatric conditions account for 13 % of total Disability Adjusted Life Years (DALYs) lost due to disease and injury worldwide. This is estimated to increase to 15% by the year 2020.(1) Depression is expected to account for 5.7% of DALYs, which means that depression alone will account for one third of all worldwide disability caused by neuropsychiatric conditions; by any measure, depression is one of the most important health problems that deserve attention and action.(1)

Depression is a chronic and recurrent disorder. The onset of depression and its recurrence occurs at different stages of the lifespan. A person may have minor or major depressive episodes. According to The Diagnostic Statistical Manual of Mental Disorders (DSM IV) TR,(4) Major Depressive Disorder is defined as –

> A. Presence of five or more of the following symptoms experienced most of the day, nearly every day, for two weeks or more and must include the first and/or second symptom below:
> 1. Depressed mood or feeling of sadness
> 2. Loss of interest and pleasure in all or most activities enjoyed in the past
> 3. Extreme feelings of guilt, worthlessness, and hopelessness
> 4. Decreased energy, feeling of fatigue
> 5. Changes in sleep or appetite
> 6. Restlessness and irritability

7. Difficulty concentrating or remembering
8. Thoughts of death or suicide

B. The symptoms do not include those for a manic or hypomanic episode (i.e., fitting the criteria for both a manic episode and a major depressive episode).

C. The symptoms cause significant distress or impairment in social and/or occupational functioning.

D. The symptoms are not due to substance use or a medical condition.

E. The symptoms are not caused by the loss of a loved one.

Depression can occur during pregnancy (antenatal depression), after birth (postpartum depression), or at both times (perinatal depression). Maternal depression encompasses a spectrum of depressive conditions that can affect expectant mothers and those up to twelve months postpartum.(5) Estimates of antenatal and postpartum depression in the general population range from 12 to 20%, and a commonly reported estimate is 13%.(6,7) In Saskatchewan, the prevalence was estimated 29.5% in the socially high-risk pregnant women group.(8) Maternal depression can have devastating consequences, not only for the mother experiencing it, but also for the child and family.(9-13)

Maternal depression has both immediate and longer-term consequences. A depressed mother may have diminished capacity for self-care, as well as care for her infant.(14) Depression during pregnancy, or antenatal depression, may compromise a woman's physical and mental health. In general, major depression was found to be associated with ischemic heart disease, diabetes, stroke, and other medical problems.(15) Also, depressed mothers reported more sleep disturbances, and anxiety.(16) Depression may impair the capacity of decision making about her own health as well as the wellbeing of the fetus.(17) They were likely to have less frequent antenatal care.(14) These may reduce optimal fetal monitoring during pregnancy.(17) Also, depression in pregnancy were found to be associated with preterm

delivery,(18) lower birth weight and small for gestational age.(19) Studies have found that postpartum depression can hamper a child's cognitive, emotional, and social development in infancy and early childhood.(20-22) Detailed evidence for the consequences of antenatal and postpartum depression is provided in the literature review.

Antenatal depression is a relatively new area of study compared to postpartum depression and the depth and sophistication of this research is still developing. However, a longitudinal study had found that the prevalence of antenatal depression is higher than postpartum depression.(23) A study in Saskatchewan had also found higher prevalence of antenatal depression (14.1% in early pregnancy; 10.4% in late pregnancy) than in postpartum period (8.1%).(24) Given the high prevalence and serious consequences of antenatal and postpartum depression, efforts have been made to identify risk factors to assist in prevention, identification, and treatment. A review of the empirical literature revealed a range of antecedent risk factors for maternal depression, as listed below.

A number of risk factors for antenatal depression have been described in the literature. Risk factors include young age,(25) low income,(26) lower educational attainment,(25) history of depression,(25,27) a history of miscarriage and pregnancy termination,(28) a history of childhood sexual abuse,(29) and low social support.(30,31)

Cigarette smoking, alcohol use, and recreational drug use were found to be associated with depression during pregnancy.(32-35) Researchers found that women who were depressed and had a negative attitude towards pregnancy were more likely to use alcohol, smoking and recreational drugs both before and after knowing they were pregnant.(32) Also, depressed women who were current smokers were found to be less confident in quitting smoking than

non depressed women.(33) Pajulo et al. found association with recreational drug use and antenatal depression as measured using the EPDS scale.(35) Researchers reported that stressful lifestyle and lack of social support would leave women at risk for using increased amount of alcohol or recreational drugs.(35,36) Marcus et al. suggested that increased use of tobacco, alcohol, or drugs could be the potential indicators of elevated depression among mothers.(25)

Meta-analysis studies have revealed a number of risk factors strongly associated with postpartum depression including history of depression, antenatal anxiety and depression, stressful life events, low social support, and low income.(37,38) Other antecedent risk factors for postpartum depression include young age,(39) lower education status,(40) a history of miscarriage and pregnancy termination,(41) and a history of childhood sexual abuse(42). Tobacco use was found significant for postpartum depression measured at well-baby visit in one study.(43) Another study also found association with antenatal alcohol use and smoking with postpartum depression.(44)

1.1 Purpose of the study

In the studies that have been published to date, very little is reported on the specific role of the risk factors, for example as moderators or mediators of the effects on depression. Understanding in greater depth the role some factors might play in the production of depression (a mitigating or a mediating role) could not only contribute to a better understanding of the mechanism of depression, but also greatly enable us to intervene to minimize the effects by focusing on certain factors or on certain patient groups. This thesis addresses this gap and investigates the role of potential risk factors, such as moderating or mediating effects of other factors, in determining the impact on maternal depression.

1.2 Definitions

Moderator variables - "A moderator is a qualitative or 'nominal' variable (e.g., sex, race, class) or a quantitative variable (e.g., level of reward) that affects the direction (i.e., mitigates or exacerbates) and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable."(45)

Mediator variables - "A given variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the outcome."(45) In other words, when a mediator is removed from a relationship between a predictor and an outcome, there will be a reduction of the strength of the association that was first observed. By identifying mediators, we may better able to describe the pathway that connects a predictor to an outcome. Moderator variables specify <u>when</u> certain effects will hold, or not, whereas mediators describe <u>how</u> or <u>why</u> such effects occur.(45)

CHAPTER 2

REVIEW OF LITERATURE

A review of the literature was conducted to determine the prevalence rates, risk factors, the relationship among risk factors (sociodemographic, psychosocial, and behavioural factors) and depressive symptoms in maternal depression, outcomes of maternal depression and moderating and mediating factors for maternal depression. Medline, Pub Med, Proquest, Google Scholar, and CINHAL databases were searched from 1990 - 2013 in addition to several selected earlier studies. For the purpose of this review the keywords used in the search were: sociodemographic, psychosocial, behavioural factors, antecedent risk factors of maternal depression, antenatal depression, postpartum depression, outcomes of antenatal and postpartum depression, consequences of depression in pregnancy or postpartum, moderating factors for mental health, maternal depression, depression in pregnancy or postpartum, and mediating factors for mental health, maternal depression, depression in pregnancy or postpartum.

2.1 Maternal Depression Worldwide

Depression is a significant health problem, affecting approximately 350 million people worldwide.(46) Depression is the leading cause of disability in term of total year lost due to disability.(46) Depression leads to about one million suicides per year.(46) It is estimated that about one in five women will develop depression at some point in her lifespan, with increasing risk during the childbearing years.(47,48)

2.2 Maternal Depression in Canada

In Canada, lifetime prevalence of major depression is estimated from 7.9% to 12% of adults over 18 years of age and living in the community.(49,50) A longitudinal study conducted by Statistics Canada (The National Population Health Survey- NPHS) found the annual incidence for women aged 12-24 highest which was 7.1% (95% CI 5.1 - 9.1).(51) In a Saskatchewan study, the prevalence for antenatal depression was found 14.1% in early pregnancy, and 10.4% in late pregnancy while the prevalence for postpartum depression was estimated at 8.1%.(24) In the same province, among the socially high-risk pregnant women group, the prevalence of depression was estimated up to 29.5%.(8)

2.3 Risk Factors for Maternal Depression

Antecedent risk factors for maternal depression include a history of depression, maternal depression from a previous pregnancy, family history of depression, life stress, poor marital relationship, lack of social support, unplanned or unwanted pregnancy, history of smoking, recreational drug abuse, and alcohol abuse.(6,52) Race/ethnicity, age, and socioeconomic status are also found predictors of maternal depression.(25,26)

2.4 Health Consequences of Maternal Depression to Mother and Child

The consequences of untreated maternal depression are of particular concern due to the effects on the health of the mother and infant. Depressed women are more likely to engage in smoking,(32,33) alcohol,(44) or recreational drug use(32,35) during pregnancy, and may decrease their compliance with prenatal health check-ups.(14) As a result, depressed mothers put themselves and their babies at risk for pregnancy complications and poor birth outcomes.

Depressed mothers are more likely to deliver baby at preterm,(53-55) and with low birth weight than non-depressed women.(53,56) Depressed mother had higher rates of operative deliveries.(56) Maternal depression had also been associated with missed pediatric appointments and greater use of emergency department services for childrens' health problems.(57) These women were less likely to breastfeed,(53,55) more likely to have newborns who are fussy,(16) and can have babies with increased rates of sudden infant death syndrome.(58).

Depressed mothers had more complex behavioural (less responsive and sensitive, and more intrusive) interactions with their children.(59) Maternal depression threatens a mother's emotional and physical ability to take care of her child.(17) Depressed mothers tend to have poor decision-making capacity over their own health as well as the health of the child.(17) Also, depressed mothers were likely to have sleep disturbance, and anxiety.(16) Newborns of these mothers tend to have irregular sleep pattern.(16) Children of depressed mothers were more likely to have insecure attachment to their mothers.(10) The lack of a secure bonding between the mother and the child also impacted mother's mental health, putting her more at risk for developing maternal depression. A study showed that the mother felt rejected with the lack of interaction with her child which further worsened her depression.(60) Children of depressed mothers are also more likely to experience worse long term mental health consequences. Research showed that there were more negative affect, poor affect regulation, less cooperation, and poorer cognitive and language skills in the children of depressed mothers.(12,13,61) Children of postpartum depressed women were more likely to be

cognitively delayed and were found to display more outwardly violent behaviours especially in the male children.(62)

2.6 Moderating and Mediating Role of the Antecedent Risk Factors

This section will discuss the application of mediating and moderating role of the antecedent risk factors in relation to depression during pregnancy or in postpartum. A mediator variable is an intermediate variable or proximal determinant that accounts for the relationship between predictor and outcome variable.(45) Mediators attempt to describe 'why' and 'how' effects occur.(45) In behavioural research, psychosocial variables such as social support and self efficacy are often hypothesized as playing mediating roles. (63) In this study, I will consider psychosocial and behavioural factors measured in late pregnancy as mediators for predicting depression symptoms in late pregnancy and postpartum. Moderator variables, on the other hand, specify the conditions under which the variable exerts its effect, such as ethnicity and gender.(45) Moderators attempt to describe 'when' and in 'whom' effects may occur. In this study, I will consider sociodemographic factors as potential moderators in analysis.

Sociodemographic Factors

Age, ethnicity, income, marital status, and education are commonly identified as sociodemographic determinants or risk factors for depression. (8,64-68) Their role as moderators in relation to maternal depression in the literature is limited. Therefore, antecedent demographic risk factors that predict maternal depression in the literature are discussed below.

Age:

Research found that younger age is vulnerable for increased risk of depression, especially for those still living with their parents.(69) Researchers had found that young age was associated with postpartum depression, but no relationship was found for young age and antenatal depression.(69) In the Pregnancy Risk Assessment Monitoring System (PRAMS) survey conducted in 17 states in the United States in 2004-2005 found that younger women with lower education, and who received Medicaid benefits for their deliveries were more likely to report postpartum depressive symptoms.(66) A study using self-administered questionnaire among young mothers who bring a child of 18 months or less at community pediatric health centers reported an average of 40% screened positive for depressive symptoms.(70,71)

Ethnicity:

In the United States, race/ethnicity was found to be an important predictor for maternal depression. One study reported the prevalence of antenatal depression and postpartum depression were higher among minorities.(67) In this study, Black and Hispanic mothers had higher prevalence of depressive symptoms compared with non-Hispanic white mothers.(67) However, these associations were explained by lower income, financial hardship, and higher incidence of poor pregnancy outcome among minority women.(67) A large epidemiological survey had found that white persons and Hispanics might be more vulnerable to major depression uncomplicated by other illness, while black persons were likely to have co-morbid depression.(72-74) Studies found that rates of depressive symptoms were estimated to be as high as 35% in African American women,(75) whereas those for Latina women varied from high to very low,(70) with low-income Latina women having uniformly high prevalence rates. In

Saskatchewan, one study among the high risk pregnancy group found that Aboriginal women had higher level of depressive symptoms than non-Aboriginal women (32.2% versus26.7%).(8) In the same study, Aboriginal women had experienced higher self-harm thoughts than non Aboriginal women. Therefore, it is important for us to know in what context Aboriginal mothers are experiencing more depressive symptoms.

Income:

A meta-analysis had found that low socio-economic people were more vulnerable for recurring major depression.(64) Other studies of depression in impoverished areas reported rates of 25% during pregnancy and 20% or more in postpartum period.(65,76,77) Bolton et al. also found that poverty was the most important risk factor for the development of antenatal depression in the inner-city pregnant mothers.(26) Other research also suggested low-income women are at particular risk for developing antenatal depression. In a study of Early Head Start programs, which served low-income children, 52 percent of the mothers reported depressive symptoms as measured by Center for Epidemiologic Studies Depression Scale (CES-D) at 14 and 36 months postpartum.(70,78)

Education:

Major depression in women was also associated low maternal education.(79) Bolton et al. also found low education to be associated with depressive symptoms in inner-city pregnant women.(26) The Pregnancy Risk Assessment Monitoring System (PRAMS) study also found that lower education among mothers was more likely to report postpartum depressive symptoms.(66)

Marital Status:

Research suggests unmarried mothers have more depressive symptoms.(26,68,80) Studies showed that depressed patients were half as likely to ever have been married than non-depressed patients and twice as likely to been separated or divorced.(68,80) Other study also found unhappy marital status predicted depression and addiction.(81) Hobfoll identified single status as the only indicator of antenatal depression in a study of high-risk women.(65) Other studies also found that single mothers were more likely to be depressed than married women and accessed mental health services more often.(82,83)

Psychosocial factors

The interaction between mental health, social support, and stress is complex.(84) Pearlin et al. (1981) described this as stress process framework. This framework was conceptualised as combination of three domains: sources of stress, mediators of stress and manifestations of stress.(84) Sources of stress were the major life events and chronic life strains; social support and coping strategies (such as-smoking, and exercise) were considered as main mediating resource; and emotional, behavioural, or any symptomatic outcome (such as-depression, and anxiety) were counted for manifestation of stress.(84)

The influence of stress and social support on maternal health during pregnancy and the postpartum period had been revealed in the literature.(38,85,86) The PRAMS study had shown that partner-related stress, traumatic stress, and financial stress during pregnancy were significantly associated with a higher likelihood of self-reported postpartum depressive symptoms in 17 states in the United States.(66). Low social support had been found to be one of the strongest predictors of postpartum depression.(37,38,87) Women who perceived

stronger social support from their partners in mid-pregnancy had lower emotional distress in postpartum period.(88)

Social Support:

Social support is important for the individuals' quality of life and physical and mental health.(89-94) Social support may affect mental health by buffering or moderating the negative effect of stress on mental health.(91,95) Olstad and colleagues (2001)(95) reported that controlling for all possible stressors, the total social support moderated the negative effect of stressors upon mental health. Again, it was also assumed that social support can influence mental health regardless of the level of stress.(91,95) Studies suggested that women who did not receive good social support during pregnancy were more likely to develop postpartum depression.(37,52) Researchers found that women who had higher levels of social support reported fewer symptoms of depression following childbirth compared with women with less supportive networks.(96,97)

Stress:

The relationship between stressors and the onset of depression is found in the literature.(66,87) Commonly identified stressors that can trigger depressive episodes in individuals were 'the death of a loved one', 'relationship breakdown or divorce', 'losing a job', or 'moving home'.(87) Pregnancy and birth were also regarded as stressful life events and may lead to depression.(87) O'Hara and Swain found moderating relationship between experiencing a life event and developing postpartum depression.(52)

Researchers concluded that a stress process framework could be useful for understanding postpartum depression both in terms of its risk factors and how it compares to

major depression.(98) Therefore, this thesis examines this complex relationship for maternal postpartum depression as well as depression during pregnancy within a stress process framework.(84)

Marital Satisfaction:

Being married and quality of marital relationship are both important predictors for depression in individuals.(68,80,81) Unhappy marital status can lead to depression and addiction as mentioned earlier.(81) Studies have reported an increased risk of postpartum depression in women who experienced marital problems during pregnancy.(38,52) Research revealed that factors such as lower education, income, and social support, predicted poor marital satisfaction during transition to parenthood.(99,100) Partners were found at greatest risk for divorce in the first five years of marriage when most couples undergo the transition to parenthood.(101) With the added responsibility of childcare, the relationship between the partners often suffered.(87) Satisfactory relationship with the partner can help to mitigate the stresses of being a new mother.(87) Thus marital satisfaction across the transition to parenthood is particularly important for marital stability, mental well-being,(52) and parent-child relationship.(102)

Behavioural Factors

Pearlin et al., (1981) had mentioned about coping strategies as possible mediators of stress. Coping strategies could be positive behavioural strategies where a person approaches to the stressors and tries to deal with them. For example, exercise would be a positive and approach-based strategy to counteract depression.(103) On the contrary, there are negative coping strategies where a person avoids the stressors or use harmful strategies to tackle the

stressors such as smoking, eating more, drinking or using drugs.(103) Literature reported that women with depression use more tobacco, alcohol, and drugs than those without depression.(13,32,104,105) Research had found an association for depressive symptoms as a co-morbid condition in postpartum period with alcohol or tobacco use during pregnancy.(44) Other studies found that alcohol, smoking, or substance use could co-occur during pregnancy.(106-108) Exposure to these substances is known to have deleterious effects on pregnancy and the fetus.(32,104) In my thesis, given the focus of mediating resources for coping strategies within stress process framework, I will test the potential mediating role of negative coping strategies smoking, alcohol, recreational drugs, as well as positive coping strategies such as exercise for predicting depression in pregnancy or postpartum.

Alcohol:

Women who drink during pregnancy have been found to be more likely to be younger than 30 years of age, unmarried, and working outside the home.(109) Research also showed that mothers who had stopped using alcohol during pregnancy had more depressive symptoms than those who had quit before pregnancy.(105)

Smoking:

Pritchard found that depression increased as the pregnancy progressed from 20 to 30 weeks for all the women and that smokers had a higher rate of depression than non smokers at both 20 and 30 weeks.(110) Women who continued to use alcohol or drugs after learning they were pregnant were more frequent smokers than spontaneous quitters, more likely to smoke cigarettes, and had more psychosocial stressors.(111) The PRAMS study also found tobacco use during late pregnancy as an important predictor for postpartum depression symptoms.(66)

Drug Use:

Substance abuse was known to have deleterious effects on pregnancy and the fetus.(32,104) There is lack of evidence of recreational drug use for moderating or mediating relationship with depression during pregnancy or postpartum.

Exercise:

Exercise is known to be a positive coping strategy.(84) Limited evidence supports a relationship between participation in exercise and reduction in postpartum depression.(112) There is lack of evidence for the relationship between exercise and antenatal depression. However, there is growing recognition and acceptance of exercise for major depression as an intervention option.(113)

History of depression

A commonly identified risk factor for maternal depression was a previous episode of antenatal or postpartum depression.(114,115) Approximately 50 to 62% of women with a history of depression would experience maternal depression.(114) Thirty percent of women with postpartum depression had their onset during pregnancy.(114) Women who experience one episode of postpartum depression have a 25% chance of experiencing depression unrelated to childbirth and 40% chance to experience another postpartum depression.(114,115) Although history of depression is an important risk factor, it cannot be thought as a moderator or mediator as this was another episode of depression which is more in line with current depression episode in pregnancy and postpartum. In this thesis, depression status in pregnancy and postpartum are considered as outcome variables. Therefore, I will not use history of depression variable for moderating or mediating analysis.

2.6 Summary of the Literature Review

Identifying the role of risk factors is central to identifying, treating, and preventing maternal depression. Researchers tried to address who postpartum depression occurs and why it occurs following the empirical literature on major depression, with increasing consideration given to the role of psychosocial variables.(116) The literature reveals an equal or greater rate of depressive symptoms in pregnancy than postpartum.(65,69,117) Limited longitudinal studies are found where researchers had addressed antenatal and postpartum depressions together in relation to the risk factors. Evidence for moderating and mediating influence of the antecedent risk factors for depression during pregnancy and postpartum are also limited. Therefore, using data from the Feeling in Pregnancy and Motherhood Study, this thesis examines the relationship among antecedent risk factors and subsequent depression symptoms both in pregnancy and postpartum. This thesis will determine the factors that moderate the relationship between antecedent risk factors and subsequent depression status in pregnancy and postpartum. Also, it will examine the mediating relationship among antecedent risk factors and subsequent depression status in pregnancy and postpartum period. Findings from this research may contribute to the understanding of the risk factors as how these buffer the relationships for occurring maternal depression and their causal influence for antenatal depression and postpartum depression among mothers. Results from this thesis would help the decision makers establish prevention and intervention efforts aimed at reducing negative maternal-child health outcomes.

CHAPTER 3

CONCEPTUAL FRAMEWORK, RESEARCH QUESTIONS, AND HYPOTHESES

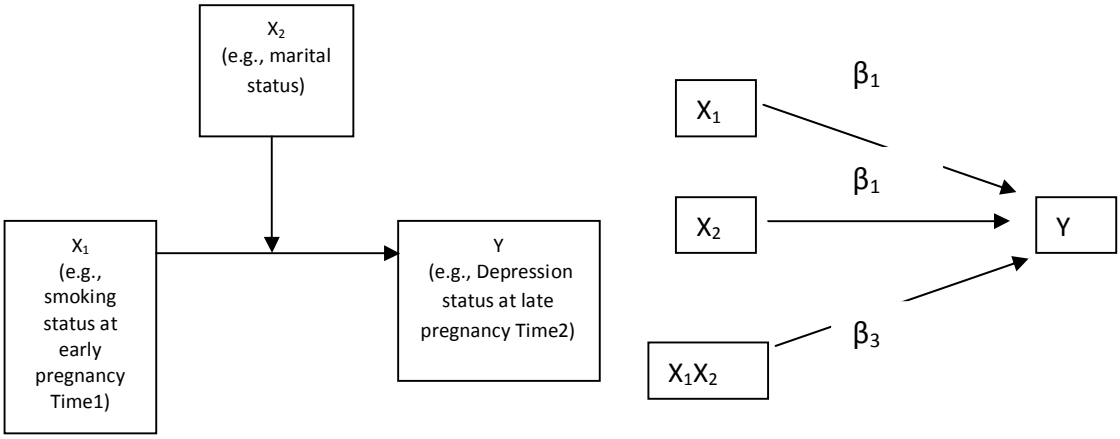
As discussed, maternal depression is a serious global health problem. The burden of maternal depression on the individual, family, and community makes depressive symptoms one of the major health care problems that requires to be addressed. Scarcity of studies on risk factors, specifically how they moderate and mediate maternal depression, makes this thesis relevant as this will improve knowledge and awareness, minimize stigma, negative impact on mothers and child and prevent maternal depression. This thesis will focus on the relationship of moderating and mediating factors over time for maternal depression which encompasses both antenatal and postpartum depression.

3.1 Moderating Analysis

Moderating analysis is used to determine whether the magnitude of an independent variable's effect on an outcome variable of interest depends on a third variable or set of variables. Figure 3.1 shows a conceptual diagram of a moderating effect model. In the model, X_1 is depicted to exert a causal influence on Y with a unidirectional arrow pointing from X_1 from Y. This effect is moderated or influenced by X_2. For further understanding, I have demonstrated this diagram using variables from the Feelings in Pregnancy and Motherhood (FIP) study. I consider sociodemographic variables such as maternal age, ethnicity, education attainment, income, and marital status as potential moderators of effects on maternal depression.

Moderators are those variables typically that are not modifiable, or have qualitative character or nominal in nature, and could also often be antecedent to other independent variables (behavioural and psychosocial) and depression. As an example, education attainment could often be seen as a factor that in time preceded a behavioural factor such as drug use (although, albeit, sometimes it is not).

Figure 3.1 Conceptual diagram for moderating effect model



In a statistical model, if the dependent variable is categorical, the equation must be rewritten for logistic regression, as in the following:

Log of the odds [Logit (ρ)] = Log (ρ/1-ρ) = $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 X_2 + \varepsilon$ (1)

Where (ρ/1-ρ) = Probability, y, of an event/ Probability, y, of no event; β_0 is the intercept; β_1, β_2, β_3 are parameter estimates; X_1, X_2 are independent risk factors; and ε is the residual error.

Using this equation with FIP study, I can rewrite:

Log (ρ/1-ρ) = log (probability of having depression/probability of not having depression)

$= \beta_0 + \beta_1$ (antecedent psychosocial-behavioural risk factor at early pregnancy) $+\beta_2$ (Antecedent socio-demographic risk factors) + β_3 (antecedent psychosocial-behavioural risk factor at early pregnancy) X (Antecedent socio-demographic risk factors) + ε

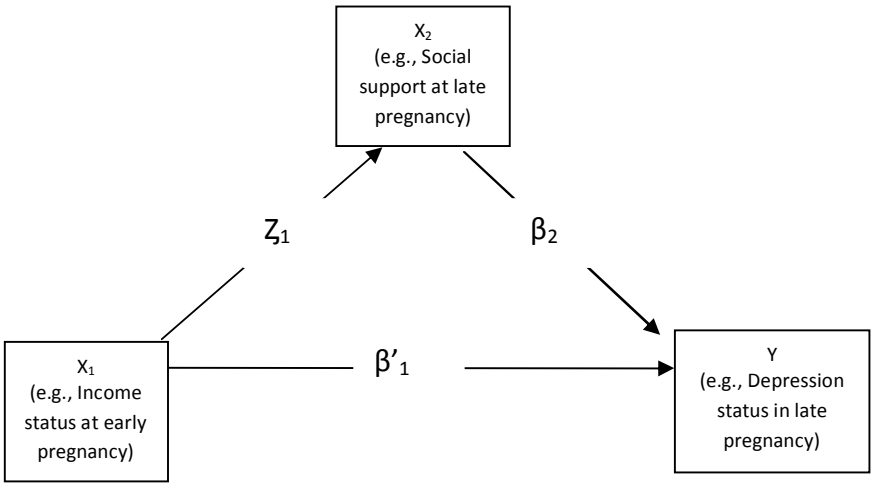
$= \beta_0 + \beta_1$ (smoking status at Time1) $+\beta_2$ (marital status) + β_3 (Smoking status at Time1) X (marital status) + ε

Here, β_3 (Smoking status at Time1) X (marital status) will show whether the effect of smoking status of the mother at early pregnancy on subsequent depression is different between mothers who are married compared to those not married. In other words, this will identify whether marital status moderates the association between smoking and subsequent depression.

3.2 Mediating Analysis

In mediating analysis, this can explain the process or pathway by which one variable affects another. Understanding the process or mechanism is important as it helps to design the interventions that could change the outcome of interest by targeting mediating variables that are hypothesized to be causally related to the outcome. In this analysis, variable X_1 is modeled to influence outcome variable Y directly as well as indirectly through intermediary or mediator variable/s. In mediating analysis, X_2 (intermediary variable) is causally located between X_1 and Y, as depicted in Figure 3.2.

Figure 3.2 Conceptual diagram for mediating model



The indirect effects of X_1 are derived from two models, one estimating X_2 from X_1

$\text{Log } (\rho/1-\rho) = Ζ_0 + Ζ_1X_1 + \varepsilon$ (2)

Using FIP study data, I can rewrite:

Log (Probability of having social support in late pregnancy/Probability of not having social support in late pregnancy)

$= Ζ_0 +$ Ζ1income status at early pregnancy + ε

and a second estimating Y from both X_1 and X_2:

$\text{Log } (\rho/1-\rho) = \beta_0 + \beta'_1X_1 + \beta_2X_2 + \varepsilon$ (3)

For example,

Log (ρ/1-ρ) = log (probability of having depression in late pregnancy/probability of not having depression in late pregnancy)

$= \beta_0 +$ β'1Income status at early pregnancy + β_2 social support at late pregnancy + ε

The direct effect of X_1 (income status at early pregnancy) on Y (Depression status at late pregnancy) is estimated with β'_1 in equation 3. It quantifies the probability of the change in Y (Depression status at late pregnancy) that is associated with one unit change on X_1 (income status at early pregnancy) independent of the effect of X_2 (social support at late pregnancy) on Y (Depression status at late pregnancy).(45)

The indirect effect of X_1 on Y through X_2 is estimated as $Ƶ_1 \beta_2$, meaning the product of the effect of X_1 on X_2 ($Ƶ_1$ in equation 2) and the effect of X_2 on Y controlling for X_1 ($\beta_2$in equation 3). It estimates the probability of how much two cases differing by a unit on X_1 (income status at early pregnancy) are estimated to differ on Y (Depression status at late pregnancy) as a result of the effect of X_1 (income status at early pregnancy) on X_2 (Social support at late pregnancy), which in turn affects Y (Depression status at late pregnancy).

The direct and indirect effects of X_1 on Y sum to yield the total effect of X_1 on Y. This total effect can also be estimated by regressing Y on X alone:

$\text{Log } (\rho/1-\rho) = \beta_0 + \beta_1 X_1 + \varepsilon$ (4)

Log (ρ/1-ρ) = log (probability of having depression in late pregnancy/probability of not having depression in late pregnancy)

$= \beta_0 + \beta_1$Income status at early pregnancy + ε

The total effect is estimated as β_1. Given that $\beta_1 = \beta'_1 + Ƶ_1 \beta_2$, it shows that the indirect effect of X_1 on Y through X_2 is equal to the difference between the total and direct effects of X_1.That is, $Ƶ_1 \beta_2 = \beta_1 - \beta'_1$. Thus, an inference about the indirect effect is therefore also an inference about the difference between the total and direct effects of X_1.

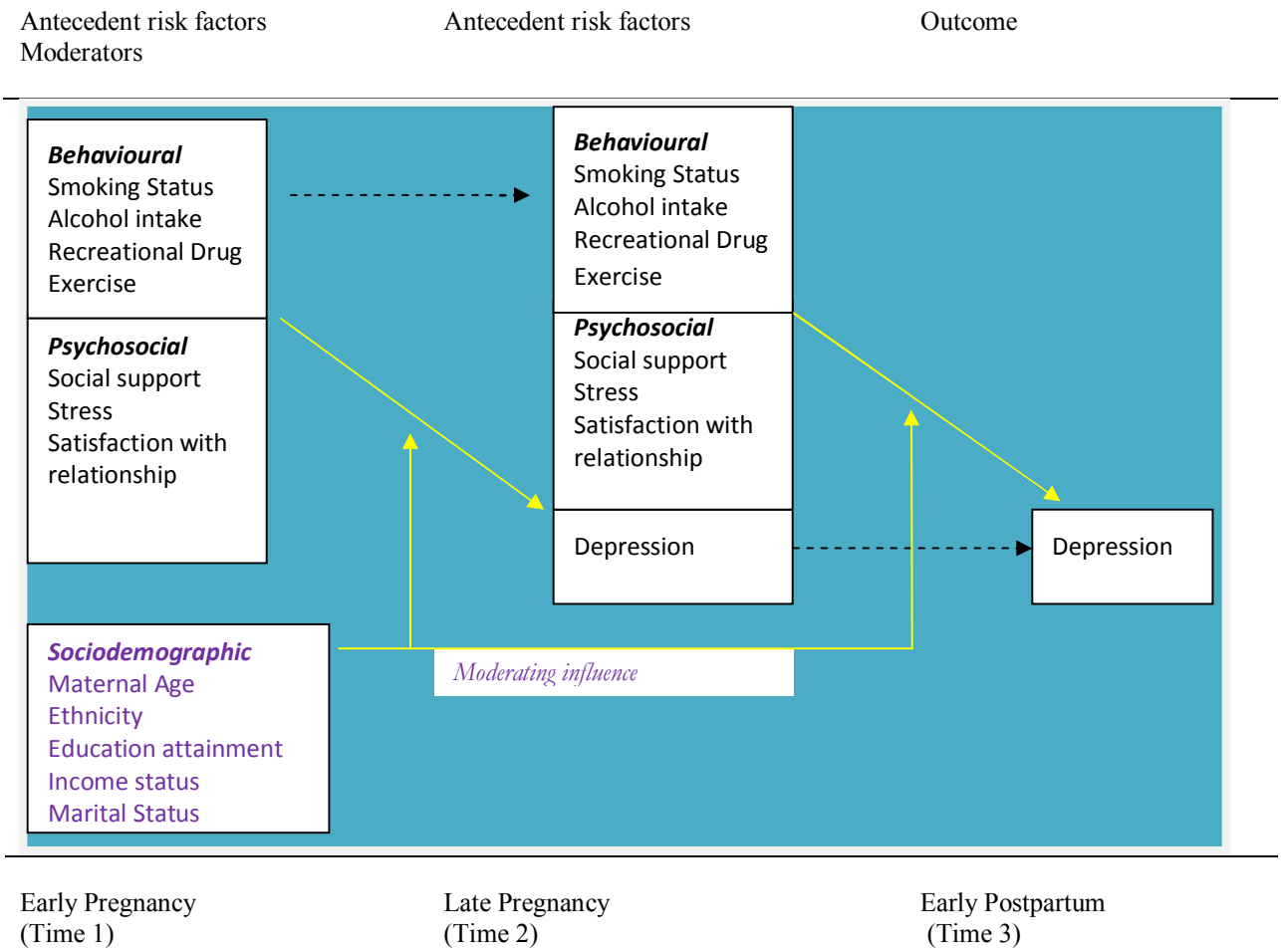
3.3 Research Questions and Hypotheses

Question 1a and Question 1b will examine the moderator relationships for depression symptoms among mothers in two time points- depression during late pregnancy (30.6 weeks ± 2.7 weeks during pregnancy) and at postpartum period (4.2± 2.1 weeks postpartum). Question 2a and Question 2b will examine mediator relationships for depression symptoms among mothers in two time points- depression during late pregnancy and postpartum. Question 3a and Question 3b will discuss how these moderator and mediator relationship taken together are affecting depressive symptoms among women at both time points. Figures were presented sequentially after each set of questions and hypotheses. Research questions and hypotheses are the following:

Question 1a: How do sociodemographic factors (such as maternal age, ethnicity, education attainment, income status and marital status) moderate the association of psychosocial (such as social support, stress, and satisfaction with relationship status) and behavioural factors (smoking, alcohol, recreational drug intake status and exercise status) measured in early pregnancy (Time 1) with depression status in late pregnancy (Time 2)? See Figures 3.3 and, 3.4.

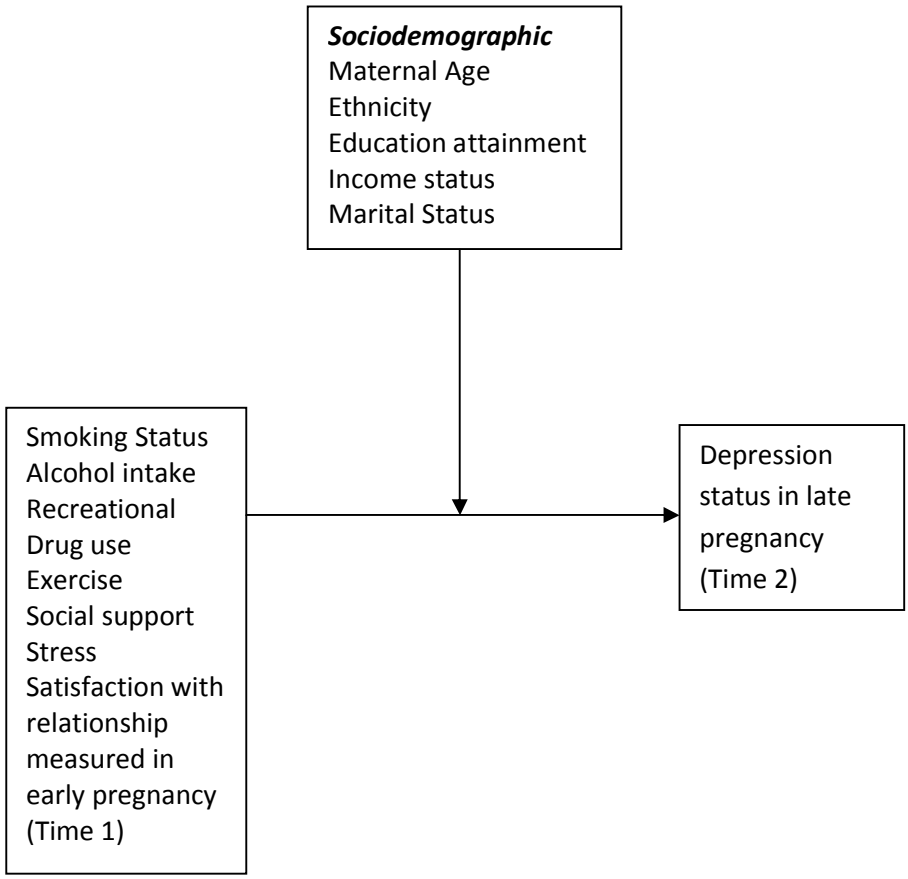
The aim in addressing this question is to understand whether and how factors related to women at the beginning of a pregnancy (such as marital status) influence the effects of what women do and/or feel on their mental health late in pregnancy.

Figure 3.3 Analytical model depicting sociodemographic variables moderating the path between antecedent psychosocial-behavioural risk factors and subsequent depression status in late pregnancy (Time 2) and early postpartum (Time 3)



NB: Broken arrows show variables that are measured repeatedly, therefore are correlated within subjects. Solid arrows show temporally-specific associations between variable domains and depression, or moderating effects.

Figure 3.4 Sociodemographic variables moderating the path between antecedent psychosocial-behavioural risk factors measured in early pregnancy (Time 1) and depression status in late pregnancy (Time 2)



Hypothesis 1a: Sociodemographic factors such as young maternal age, Aboriginal ethnicity, lower education attainment, low income, and single mother status will increase the depression status in late pregnancy (Time 2) among women who have low social support, low satisfaction with relationship, high stress level, positive status of smoking, alcohol and recreational drug

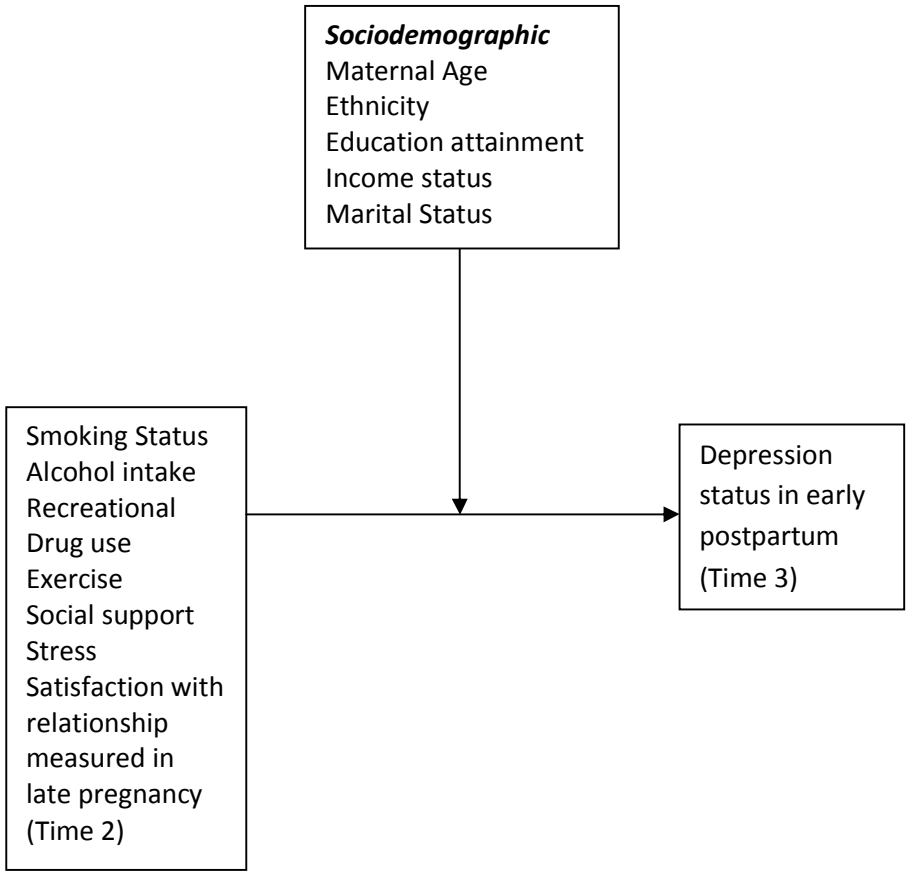
consumption and lower level of exercise measured in early pregnancy period (Time 1). See Figure 3.4.

Question 1b: How do sociodemographic factors (such as maternal age, ethnicity, education attainment, income status and marital status) moderate the association of psychosocial (such as social support, stress, and satisfaction with relationship status) and behavioural factors (smoking, alcohol, recreational drug intake status and exercise status) measured in late pregnancy (Time 2) with depression status in early postpartum period (Time 3)? See Figures 3.3 and, 3.5.

The aim in addressing this question is to understand whether and how factors related to women at the beginning of a pregnancy (such as marital status) influence the effects of what women do and/or feel on their mental health in early postpartum.

Hypothesis 1b: Sociodemographic factors such as young maternal age, Aboriginal ethnicity, lower education attainment, low income and single mother status will increase the depression status in early postpartum period (Time 3) among the mothers who have low social support, low satisfaction with relationship, high stress level and positive status of smoking, alcohol, recreational drug consumption, and lower level of exercise measured in late pregnancy period (Time 2). See Figure 3.5.

Figure 3.5 Sociodemographic variables moderating the path between antecedent psychosocial-behavioural risk factors measured in late pregnancy (Time 2) and depression status in early postpartum (Time 3)

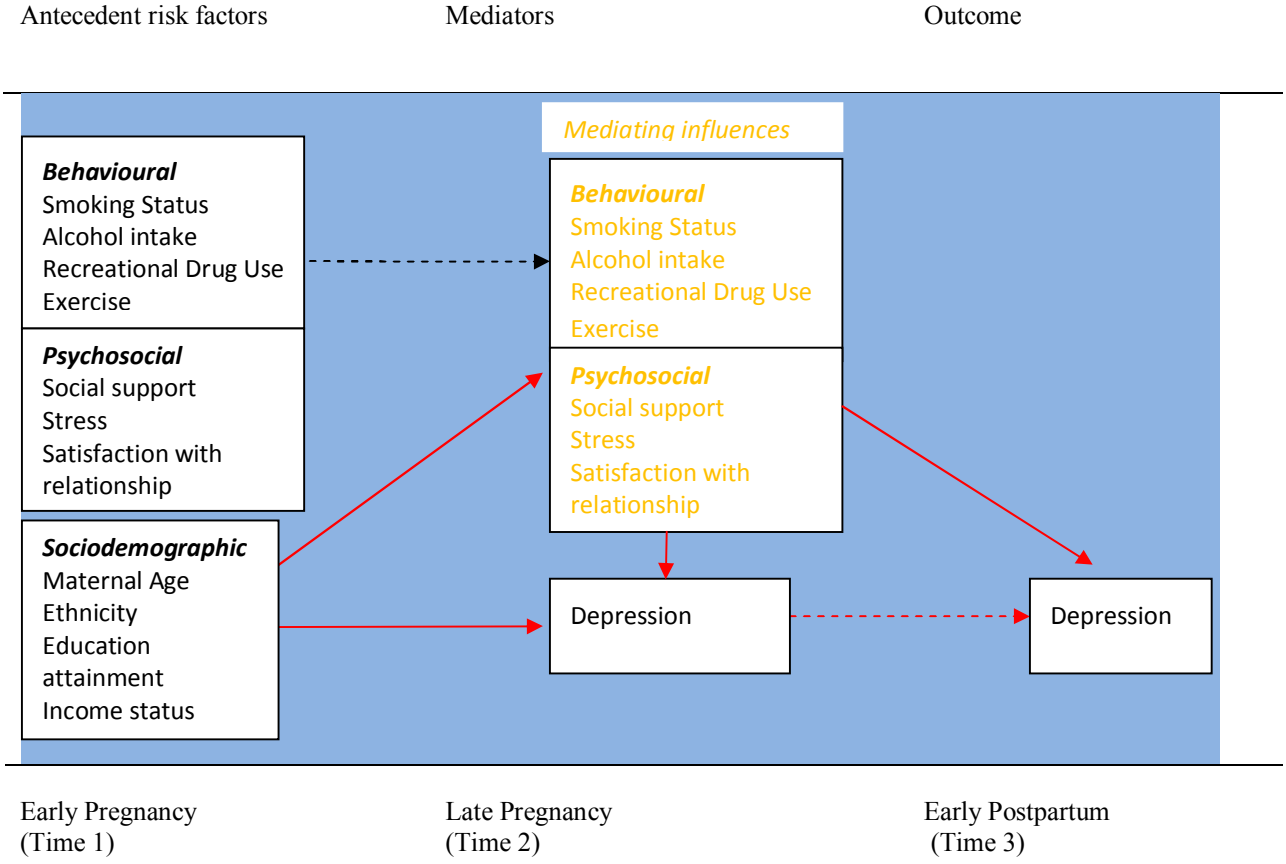


Question 2a: How do psychosocial (such as social support, stress and satisfaction with relationship) and behavioural factors (smoking, alcohol, recreational drug intake status and exercise status) measured in late pregnancy (Time 2) mediate the association between independent risk factors (such as maternal age, ethnicity, education attainment, income status, marital status, smoking, alcohol consumption, recreational drug intake, exercise status, social support, stress and satisfaction with relationship) measured in early pregnancy (Time 1)with depression status in late pregnancy (Time 2)? See Figures 3.6 and, 3.7.

The aim in addressing this question is to understand whether and how factors related to women at late pregnancy (such as social support) mediate the effects of antecedent risk factors on their mental health in late pregnancy.

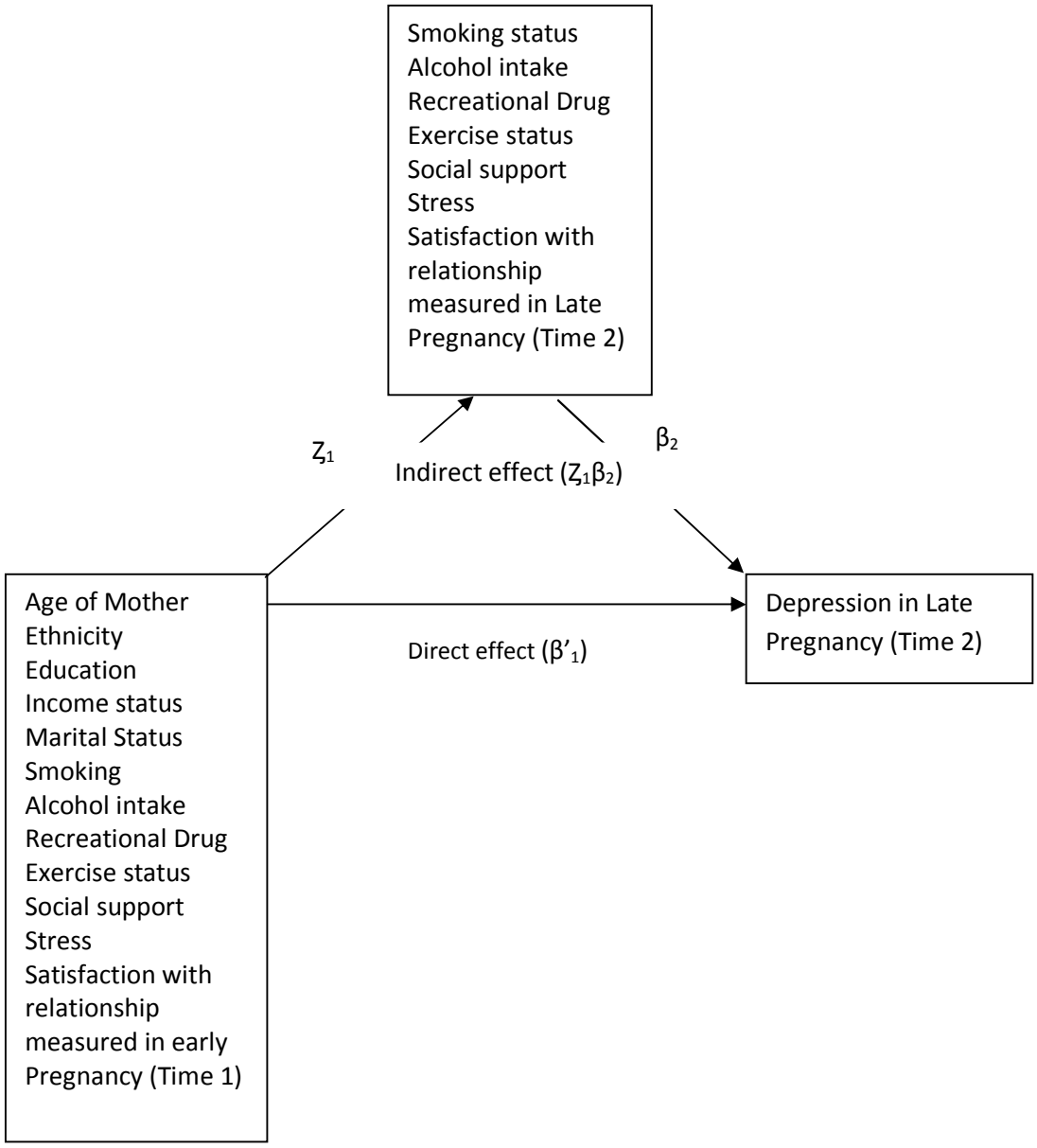
Hypothesis 2a: One or more psychosocial (such as social support, stress and satisfaction with relationship) or behavioural factors (smoking, alcohol, recreational drug intake status and exercise status) measured in late pregnancy (Time 2) will mediate the association between independent risk factors (such as maternal age, ethnicity, education attainment, income status, marital status, smoking, alcohol consumption, recreational drug intake, exercise status, social support, stress and satisfaction with relationship) measured in early pregnancy (Time 1) with depression status in late pregnancy (Time 2). See Figure 3.7.

Figure 3.6 Analytical model depicting variables measured in late pregnancy (Time 2) mediating in the path between antecedent sociodemographic-psychosocial-behavioural risk factors measured in early pregnancy (Time 1) and subsequent depression status in late pregnancy (Time 2) and early postpartum (Time 3)



NB: Broken arrows show variables that are measured repeatedly, therefore are correlated within subjects. Solid arrows show temporally-specific associations between variable domains and depression, or moderating effects.

Figure 3.7 Psychosocial and behavioural risk factors in late pregnancy (Time 2) mediating in the path between independent risk factors measured in early pregnancy (Time 1) and depression in late pregnancy (Time2)

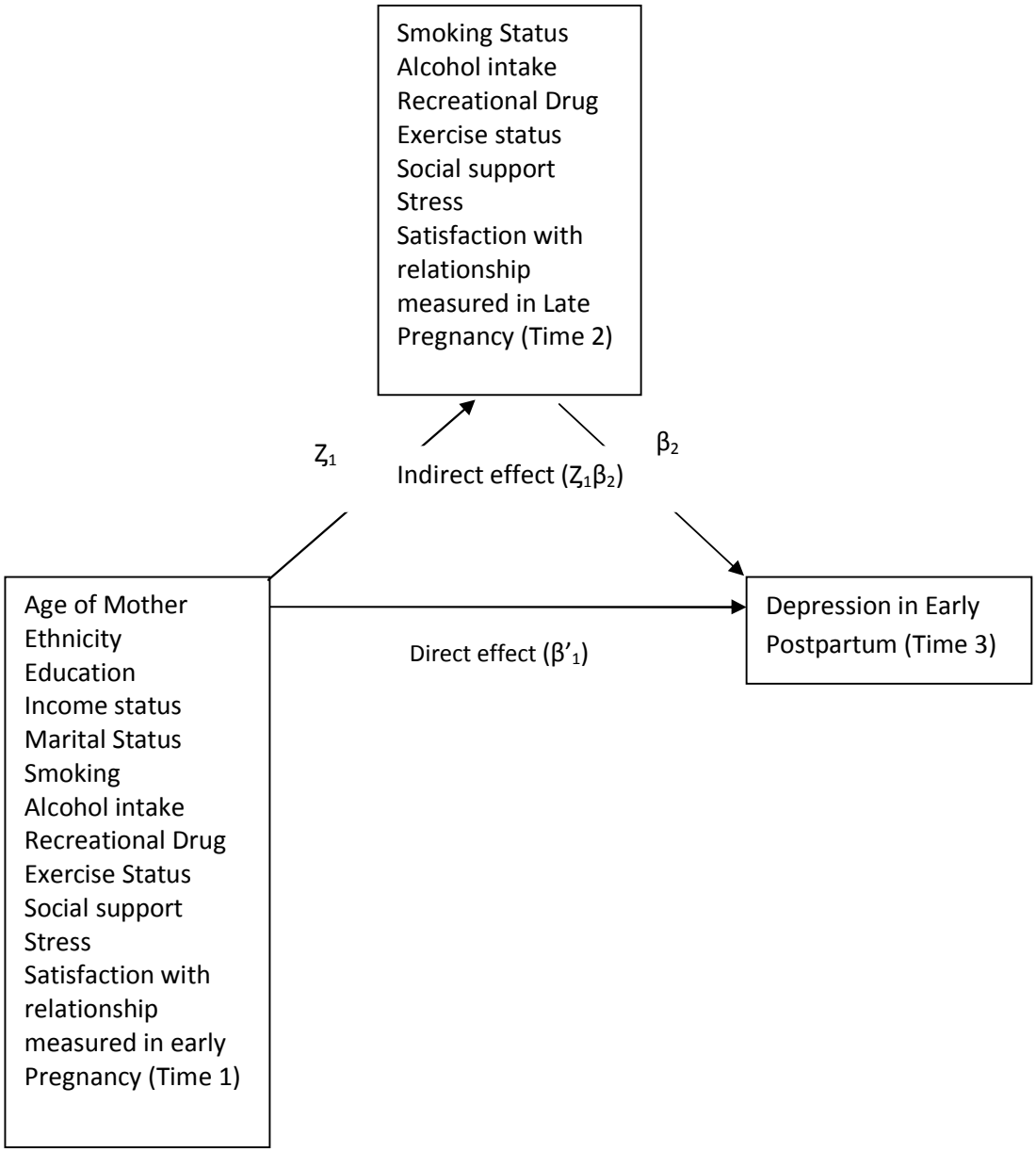


Question 2b: How do psychosocial (such as social support, stress and satisfaction with relationship) and behavioural factors (smoking, alcohol, recreational drug intake status and exercise status) measured in late pregnancy (Time 2) mediate the association between independent risk factors (such as maternal age, ethnicity, education attainment, income status, marital status, smoking, alcohol consumption, recreational drug intake, exercise status, social support, stress and satisfaction with relationship) measured in early pregnancy (Time 1) with depression status in early postpartum period (Time 3)? See Figures 3.6 and, 3.8.

The aim in addressing this question is to understand whether and how factors related to women at late pregnancy (such as social support) mediate the effects of antecedent risk factors on their mental health in postpartum.

Hypothesis 2b: One or more psychosocial (such as social support, stress and satisfaction with relationship) or behavioural factors (smoking, alcohol, recreational drug intake status and exercise status) measured in late pregnancy (Time 2) will mediate the association between independent risk factors (such as maternal age, ethnicity, education attainment, income status, marital status, smoking, alcohol consumption, recreational drug intake, exercise status, social support, stress and satisfaction with relationship) measured in early pregnancy (Time 1) with depression status in early postpartum period (Time 3). See Figure 3.8.

Figure 3.8 Psychosocial and behavioural risk factors in late pregnancy (Time 2) mediating in the path between independent risk factors measured in early pregnancy (Time 1) and depression in early postpartum period (Time 3)

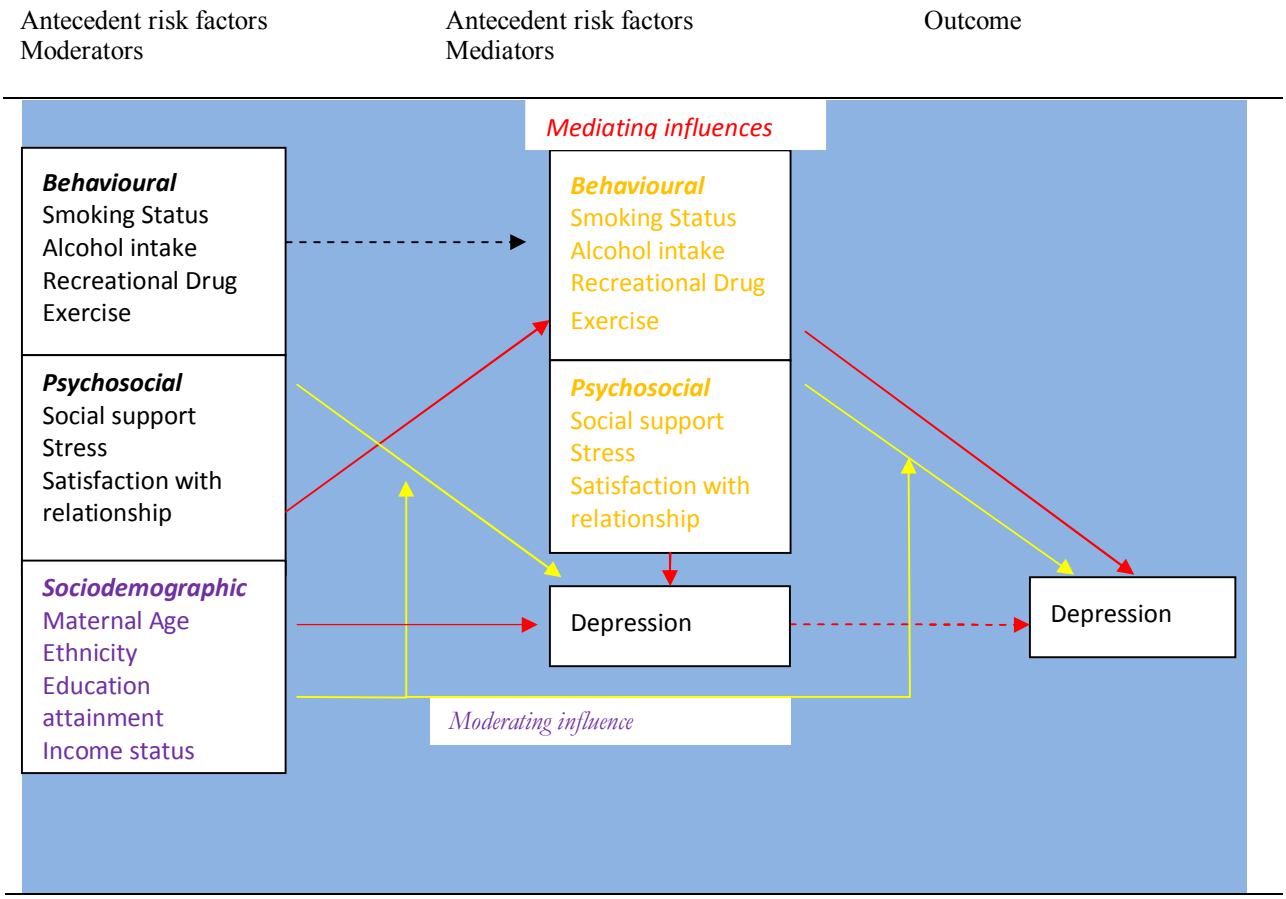


Question 3a: How do antecedent risk factors such as sociodemographic factors (maternal age, ethnicity, education attainment, income status and marital status), psychosocial (social support, stress and satisfaction with relationship status), behavioural factors (smoking, alcohol, recreational drug intake and exercise status) measured in early pregnancy (Time 1) along with psychosocial and behavioural factors measured in late pregnancy (Time 2) simultaneously moderate and mediate the association with depression status in late pregnancy (Time 2)? See Figure 3.9.

The aim in addressing this question is to understand on whom and how factors related to women at early pregnancy (such as marital status) or at late pregnancy (such as social support) moderate or mediate the effects on their mental health in late pregnancy taken consideration in together.

Hypothesis 3a: Antecedent risk factors such as sociodemographic factors (maternal age, ethnicity, education attainment, income status and marital status), psychosocial (social support, stress and satisfaction with relationship status), behavioural factors (smoking, alcohol, recreational drug intake and exercise status) measured in early pregnancy (Time 1) along with psychosocial and behavioural factors measured in late pregnancy (Time 2) simultaneously will moderate and mediate the association with depression status in late pregnancy (Time 2).

Figure 3.9 Antecedent risk factors simultaneously moderating and mediating relationship with depression in late and early postpartum period



NB: Broken arrows show variables that are measured repeatedly, therefore are correlated within subjects. Solid arrows show temporally-specific associations between variable domains and depression, or moderating effects.

Question 3b: How do antecedent risk factors such as sociodemographic factors (maternal age, ethnicity, education attainment, income status and marital status), psychosocial (social support, stress and satisfaction with relationship status), behavioural factors (smoking, alcohol, recreational drug intake and exercise status) measured in early pregnancy (Time 1) along with psychosocial and behavioural factors measured in late pregnancy (Time 2) simultaneously moderate and mediate the association with depression status in early postpartum period(Time 3)? See Figure 3.9.

The aim in addressing this question is to understand whom and how factors related to women at early pregnancy (such as marital status) or at late pregnancy (such as social support) moderate or mediate the effects on their mental health in postpartum taken consideration in together.

Hypothesis 3b: Antecedent risk factors such as sociodemographic factors (maternal age, ethnicity, education attainment, income status and marital status), psychosocial (social support, stress and satisfaction with relationship status), behavioural factors (smoking, alcohol, recreational drug intake and exercise status) measured in early pregnancy (Time 1) along with psychosocial and behavioural factors measured in late pregnancy (Time 2) simultaneously will moderate and mediate the association with depression status in early postpartum period (Time 3).

CHAPTER 4

METHODOLOGY

4.1 Sample

This study is based on a secondary analysis of data from the Feeling in Pregnancy and Motherhood study (FIP). The study was funded by Canadian Institute of Health Research (CIHR) and the grant number for this project was IGP-77895. The study design was a longitudinal cohort study using data gathered through face-to-face interviews. There were 649 participants in the FIP study. Participants eligible for the study were pregnant women with less than 20 weeks gestation, English speaking, and residing in either the Saskatoon or Moose Jaw health region. Women were recruited from the community through posters in doctors' offices, prenatal and breastfeeding classes, maternity stores, daycares, recreation facilities, and hospitals, as well as newspaper and radio ads, welcome wagon parties, leisure guides, and word of mouth. The patients were assessed at three points of time: Time 1=early pregnancy (17.4 $\pm$ 4.9 weeks); Time 2=late pregnancy (30.6 $\pm$ 2.7 weeks); and Time 3=postpartum (4.2 $\pm$ 2.1 weeks). The outcomes of interest were depression during pregnancy and the early postpartum period, as defined by a score of 12 or more on the Edinburgh Postnatal Depression Scale (EPDS). Each participant was assessed by research assistants. The assessors had received formal training in using study tools. Ethical approval for this secondary analysis was obtained from the Office of Research Ethics at University of Saskatchewan (see Appendix A). Informed consent was obtained from all participants.

4.2 Measures

The outcomes of interest were depression during pregnancy and the early postpartum period, as defined by a score of 12 or more on the Edinburgh Postnatal Depression Scale (EPDS). (Appendix B) EPDS is a well-established tool for assessing depressive symptoms and has been validated in many languages worldwide and conducted in different populations in many settings.(118) Sensitivity for EPDS ranges from 68 to 100%, specificity from 78 to 96%, and the positive predictive value 70 to 91% in postpartum women.(119) However, it was validated for screening antenatal depression.(119) The EPDS was validated for Saskatchewan Aboriginal women.(47) The strength of using EPDS, as research suggested it is convenient of use, has extensive validation, and is available non-commercially.(119) Also, it does not include the somatic symptoms of depression, which could be masked by somatic symptoms of the pregnancy (loss of appetite, nausea, feeling tired, and headache).(120)

The EPDS is a tool, which can be self-administered by the patient. It includes 10 items with a Likert scale of responses scored from 0-3, to a maximum score of 30. An EPDS score of 9/10 suggested for routine primary health care use whereas a score 12/13 was suggested as a threshold for suffering a depressive illness of varying severity.(120) It is noteworthy to mention that this tool is not a substitute for clinical assessment and score below the cut-off value should not be taken to indicate as absence of depressive episode.(120)

Demographic characteristics (such as age, ethnicity, income, education, marital status) as well as history of depression were collected at the initial interview. History of depression, although an important predictor for antenatal and postpartum depression, I did not include in the moderating and mediating analysis. History of depression tells us about previous episode of

major or minor depression, which can be co-related with the depression episode in the current pregnancy. Therefore, history of depression had been identified in the literature as a significant risk factor. However, this previous history of depression is more in line with the current outcome variable depression status at early pregnancy (Time 1), late pregnancy (Time 2) or postpartum (Time 3), which can be thought as repetitive measures of depression in a spectrum. In this thesis, I am not trying to identify risk factors; rather I am going to look for moderating and mediating variables; those variables that may modify or mediate the outcome variable depression status at late pregnancy (Time 2) and postpartum (Time 3). A risk factor may be considered as a moderator when they are potentially modifiable (such as - behavioural risk factors, e.g., smoking, and alcohol) or those that could be used to identify and target groups of pregnant women for specific interventions (e.g., young, Aboriginal status). As history of depression variable is neither a modifiable factor nor one that enters into consideration for as a mediator, this variable was excluded from the analysis.

Sociodemographic Factors

Age: Research has found relationship between younger age and increased risk for depression. In the analysis, age (years) was treated as both a continuous and a categorical variable (<25 years and 25 years or over) in the analysis.

Marital Status: Women were categorized as non-partnered if they were single, divorced, or widowed and partnered if they were married or in a common-law relationship.

Ethnicity: Aboriginal women are at risk of maternal depression. Women who self-identified as First Nations or Métis were categorized as Aboriginal and all other women were identified as non-Aboriginal in this analysis.

Education: Education level was collected as a categorical variable. It was dichotomized to represent those women who had or who had not completed Grade 12.

Income: Income was assessed through as social assistance, under <$20,000 per year, $20,000 to $39,000 per year, $40,000-$60,000 per year, and >$60,000 per year. This was dichotomized to <$40,000 and social assistance versus those earn$40,000 or over.

Psychosocial Factors

Participants psychosocial such as stressors, social support, and relationship status were collected in each time point.

Stress: Women were asked to identify specific sources of stress that they were presently experiencing from a list. Stressors within the list were 'Being pregnant', 'Partner/relationship', 'Not enough money', 'Children', 'Family', 'Where I live', 'Health of my baby', 'Birth of my baby', 'Own health', 'Work', 'School, and 'Other stressor'. The 12 items were summed into one composite variable. This summed variable was dichotomised as low level (0-2 stressors) and high level (>2 stressors) of stress. This was determined by changing the cut off value to achieve the maximum contrast to predicting depressive episodes.

Support: Social support was determined by two questions: “Do you have someone to turn to for emotional support?” and mothers were asked to list those people they could rely on for support and "Can you count on them to care about you no matter what?” These two questions were combined to make one composite variable for social support. This summed variable was dichotomised as low level (0-1 support) and high level (>1 support) of social support. This was determined by changing the cut off value to achieve the maximum contrast to predicting depressive episodes.

Marital Satisfaction: Mothers were asked: “Are you in a relationship now?” and “Are you satisfied with the relationship?” Responses for the second question were recoded to two categories for analysis- 'very satisfied' and 'not satisfied'.

Behavioural Factors

Smoking: Participants were asked if they smoked, if they had ever smoked, the amount smoked per day in the last month, or if they had quit before or since becoming pregnant. Smoking was analyzed by creating dichotomous variable: never smoked or ever smoked (before or during pregnancy).

Alcohol: Mother were asked if they drink, drinking 5 or more drinks at one sitting (binge drinking), and drinking of 1- 2 drinks every day in the last month, or if they had quit using alcohol during or before pregnancy. The variable was recoded into two categories of alcohol use: never used alcohol or ever used alcohol (before or during pregnancy)

Drug Use: Participants were asked whether they had used illicit drugs such as cocaine, crystal meth, and marijuana in the past month or if they had quit during or before pregnancy or never used. The variable was recoded into two categories: never used drug versus ever use drug (before or during pregnancy).

Exercise: Women were offered options about the frequency of exercise (e.g., 20 minutes of walking, swimming etc.) on daily basis in the last month. The variable was dichotomised as never exercise versus ever exercise.

4.3 Analysis

Using SPSS (PASW version 20) software, descriptive statistics of the study participants for Feeling in Pregnancy and motherhood (FIP) study is provided in Table 1. The difference between completers and non completers was tested using chi-square analysis.

Bivariate analysis is conducted to determine the association of the antecedent risk factors such as maternal age, ethnicity, education attainment, income status and marital status, social support, stress and satisfaction with relationship status, smoking, alcohol, recreational drug intake and exercise status measured in early pregnancy (Time1) for subsequent depression status at late pregnancy (Time 2) and early postpartum period (Time 3). For initial bivariate analysis, p value was set to < 0.25 for testing significance. Variables which were significant where p value was < 0.25, kept for checking moderating and mediating relationship. In the final result of moderating and mediating relationship, p value was set to <0.05 for testing significance.

Afterwards, I was interested in identifying antecedent factors that increase the risk of depression subsequently, and their specific role as moderators (Hypothesis 1a and Hypothesis 1b) or mediators (Hypothesis 2a and Hypothesis 2b) in this process. In this study, as I mentioned earlier, I consider sociodemographic variables such as maternal age, ethnicity, education attainment, income, and marital status as potential moderators.

Psychosocial and behavioural risk factors (social support, stress and satisfaction with relationship status, smoking, alcohol, recreational drug intake and exercise status) measured at late pregnancy (Time 2) are considered as potential mediators of the relationship between other independent variables (maternal age, ethnicity, education attainment, income status and

marital status, social support, stress and satisfaction with relationship status, smoking, alcohol, recreational drug intake and exercise status measured in early pregnancy (Time1) and depression status at either late pregnancy (Time 2) or early postpartum (Time 3).

To test for the moderators and mediators, a series of logistic regression analyses were conducted. Steps of the moderator and mediator analysis briefly described in the following. The Wald chi-square test ($\chi 2$) was used to test the significance of hypotheses. Statistical significance was set at $p<0.05$.

Moderating Analysis:

Three hierarchical multiple regression analyses were conducted for dependent variable depression status in late pregnancy (Time 2). In hierarchical regression model, the order of entry was as follows. At step 1, the predictor variables such as stress, social support, marital satisfaction, smoking and recreational drug use were entered into the regression equation for predicting depression status at late pregnancy (Time 2). At step 2, the moderator variables such as age of mother, marital status, income, educational attainment, and ethnicity were entered into the regression equation. At step 3, the interaction of the predictor and moderator variables were included once they were significant in Step 2. Interaction terms, which were significant, were kept in the model, which indicated a significant moderator effect.

Mediating Analysis:

Mediating analysis traditionally involves four steps.(45) First, the predictor variable must correlate with the dependent variable. Second, the predictor must be related to the mediator variable. Third, the mediating variable must be significantly related to the dependent variable when both the independent variable and mediating variable are predictors of the dependent

variable in Equation 2. Fourth, the coefficient relating the independent variable to the dependent variable must be larger (in absolute value) than the coefficient relating the independent variable to the dependent variable in the regression model with both the independent variable and the mediating variable predicting the dependent variable. If independent variable is no longer significant when mediator variable is controlled, the finding supports full mediating effect. If independent variable is still significant (i.e., both independent variable and mediating variable both significantly predict dependent variable), the finding supports partial mediating effect.

Mediating analysis for Time 2 late pregnancy depression status and Time 3 postpartum period, potential mediators those considered were psychosocial and behavioural risk factors such as social support, stress and satisfaction with relationship status, smoking, alcohol, recreational drug intake and exercise status measured at late pregnancy (Time 2).

In addressing the hypothesis 3a and hypothesis 3b, significant moderators and mediators that were found in Question 1 (for moderating analysis) and in Question 2 (for mediating analysis) were synthesised and presented in Chapter Five (Results section).

CHAPTER 5

RESULTS

The results presented in this section are based on the secondary analyses of data from a sample of 649 pregnant women in Saskatoon and Moose Jaw health region. Thirty-five women were lost to follow up and twenty-one did not complete the study because of fetal or neonatal loss. Study participants who did not complete the study in the postpartum period (Time 3) were significantly more likely to be younger age, non partnered, Aboriginal origin, less than Grade 12 and income less than $40,000. However, there were no significant difference among study participants between early pregnancy enrolment (Time 1) and those who remained in the late pregnancy follow up (Time 2). (See Table 5.1).

Table 5.1: Comparison of the participants who did not complete the study in late pregnancy and early postpartum after initial enrolment in early pregnancy

Variable	Early pregnancy enrolment (Time 1) N (%)	Late pregnancy Follow up non completers (Time 2) n (% within category)	P value	Postpartum Period Follow up non Completers (Time 3) n (% within category)	P value
Maternal age					
<25 years age	108 (16.6)	4 (3.7)	≥0.05	18 (16.7)	≤0.001
25 years or over	541 (83.4)	40 (7.4)		38 (7.0)	
Marital Status					
Married/Common Law Partner	584 (90)	39 (6.7)	≥0.05	42 (7.2)	≤0.001
Single/Divorced/Separated /Widowed	65 (10)	5 (7.7)		14 (21.5)	
Income status					
$40,000 or over	432 (66.6)	35 (8.1)	≥0.05	20 (4.6)	≤0.001
<$40,000	206 (31.7)	9 (4.4)		33 (16.0)	

Education Attainment					
<12 grade	33 (5.1)	2 (6.1)	≥0.05	13 (39.4)	≤0.001
12 grade or over	616 (94.9)	42 (6.8)		43 (7.0)	
Ethnicity					
Aboriginal	55 (8.5)	3 (5.5)	≥0.05	16 (29.1)	≤0.001
Non Aboriginal	593 (91.4)	41 (6.9)		39 (6.6)	

5.1 Participant characteristics

Sample characteristics are presented in Table 5.2. Participants were more likely to be greater than 25 years of age (83.4%), in married or common-law relationships (90%), had income more than $40,000 (66.6%) per year, and had higher than grade 12 education (94.9 %). There were 8.5% Aboriginal mothers. The Aboriginal women in this study experienced significantly lower income compared to non Aboriginal women (79.2% versus 27.9%), lower levels of education (25.5% versus 3.0%), and less social support (38.2% versus 16.0%). Aboriginal women also were significantly more likely to have used tobacco (74.5% versus 30.7%) and recreational drugs (56.4% versus 16.7%) compared to non Aboriginal mothers. Significantly higher proportion of Aboriginal women had depressive symptoms (40.0% versus 11.5%) at early pregnancy period compared to non Aboriginal mothers. Women under 25 were more likely to have lower income (67.3% versus 25.5%) and being non partnered (26.9% versus 6.7%) and they were significantly more likely to have used tobacco (56.5% versus 30.2%), alcohol (78.7% versus 70.6%), and drugs (38.0% versus 16.5%). Higher proportion of women under 25 years of age experienced depression (24.1% versus 12.0%) at early pregnancy period compared to women 25 years of age or older.

Table 5.2 Characteristics of the participants

Variables	Participants N (%)
Maternal age	
<25 years age	108 (16.6)
25 years or over	541 (83.4)
Marital Status	
Married/Common Law Partner	584 (90)
Single/Divorced/Separated/Widowed	65 (10)
Income status	
$40,000 or over	432 (66.6)
<$40,000	206 (31.7)
Education Attainment	
<12 grade	33 (5.1)
12 grade or over	616 (94.9)
Ethnicity	
Aboriginal	55 (8.5)
Non Aboriginal	593 (91.4)
History of Depression	
Yes	299 (46.1)
No	350 (53.9)

5.2 Bivariate Analysis

Table 5.3 presents bivariate analysis of the sample's characteristics by Time 2 late pregnancy EPDS depression status. Sociodemographic, behavioural, and psychosocial characteristics measured in early pregnancy were considered in this analysis. Analysis showed that the participants were more likely to be depressed in late pregnancy (Time 2) if they were less than 25 years of age, not married or not in a common law relationship, had income less than $40,000, had less than grade 12 education, or were of Aboriginal origin. Behavioural risk

factors such as mothers who ‘ever smoked’ or reported having taken recreational drugs in early pregnancy were more likely to have depressive symptoms during late pregnancy (Time 2).

Alcohol consumption and exercise were not found significantly associated with depressive symptoms in late pregnancy. Pregnant women who reported high level of stress, had low social support, and were not satisfied with marital relationship were found more likely to have depressive symptoms during late pregnancy.

Table 5.3 Relationship between antecedent risk factors at early pregnancy (Time 1) with depression status at late pregnancy (Time 2)

Variable Name	Depression at late pregnancy (Time 2) N = 649 (%)		Significance level (p value)
	Depressed	Not Depressed	
Maternal age			
<25 years age	16 (18.0)	73 (82.0)	≤0.01
25 years or over	46 (8.9)	468 (91.1)	
Marital Status			
Married/Common Law Partner	50 (9.2)	495 (90.8)	≤0.01
Single/Divorced/Separated /Widowed	12 (20.7)	46 (79.3)	
Income status			
$40,000 or over	30 (7.2)	384 (92.8)	≤0.001
<$40,000	29 (16.1)	151 (83.9)	
Education Attainment			
<12 grade	5 (21.7)	18 (78.3)	≤0.25
12 grade or over	57 (9.8)	523 (90.2)	
Ethnicity			
Aboriginal	12 (26.7)	33 (73.3)	≤0.001
Non Aboriginal	50 (9.0)	507 (91.0)	
Smoking status at early pregnancy			
Ever smoker	35 (17.2)	169 (82.8)	≤0.001
Never smoker	27 (6.8)	372 (93.2)	
Drinking status at early pregnancy			
Ever drinker	47 (10.9)	386 (89.1)	≥0.25
Never drinker	15 (8.8)	155 (91.2)	
Recreational drug use at early pregnancy			
Ever drug user	21 (18.4)	93 (81.6)	≤0.01
Never drug user	41 (8.4)	447 (91.6)	
Exercise at early pregnancy			
Ever exercise	54 (10.3)	471 (89.7)	≥0.25
Never exercise	8 (10.3)	70 (89.7)	
Stress at early pregnancy			
Low stress	19 (5.3)	339 (94.7)	≤0.001
High stress	43 (17.6)	202 (82.4)	
Social support at early pregnancy			
Low support	15 (14.9)	86 (85.1)	≤0.25
High support	47 (9.4)	455 (90.6)	
Relationship status at early pregnancy			
Very satisfied	34 (6.7)	470 (93.3)	≤0.001
Not satisfied	22 (28.6)	55 (71.4)	

Table 5.4 presents bivariate analysis of the sample's characteristics by Time 3 postpartum EPDS depression status. Sociodemographic, behavioural and psychosocial characteristics measured in late pregnancy were considered for the analysis. Analysis showed that the participants were more likely to be depressed in postpartum period (Time 3) if they were less than 25 years of age, had less than grade 12 education, or were of Aboriginal origin. Marital status and income were not significantly associated with postpartum depression (Time 3). Behavioural risk factors such as mothers who reported ever smoked or reported never exercised in late pregnancy were more likely to have had depressive symptoms during postpartum period (Time 3). Alcohol consumption and recreational drug use were not significantly associated with depressive symptoms in postpartum period. Pregnant women who reported high level of stress, had low social support, and not satisfied with marital relationship were more likely to have had depressive symptoms during postpartum.

Table 5.4 Relationship between antecedent risk factors at late pregnancy (Time 2) with depression status at postpartum (Time 3)

Variable Name	Depression at postpartum (Time 3) N= 649 (%)		Significance level (p value)
	Depressed	Non depressed	
Maternal age			
<25 years age	12 (13.3)	78 (86.7)	≤0.05
25 years or over	36 (7.2)	467 (92.8)	
Marital Status			
Married/Common Law Partner	42 (7.7)	500 (92.3)	≥0.25
Single/Divorced/Separated /Widowed	6 (11.8)	45 (88.2)	
Income status			
$40,000 or over	31 (7.5)	381 (92.5)	≥0.25
<$40,000	16 (9.2)	157 (90.8)	
Education Attainment			
<12 grade	4 (20.0)	16 (80.0)	≤0.05
12 grade or over	44 (7.7)	529 (92.3)	
Ethnicity			
Aboriginal	6 (15.4)	33 (84.6)	≤0.25
Non Aboriginal	42 (7.6)	512 (92.4)	
Smoking status at late pregnancy			
Ever smoker	15 (14.2)	91 (85.8)	≤0.05
Never smoker	33 (7.0)	440 (93.0)	
Drinking status at late pregnancy			
Ever drinker	10 (7.0)	132 (93.0)	≥0.25
Never drinker	38 (8.7)	399 (91.3)	
Recreational drug use at late pregnancy			
Ever drug user	1 (4.2)	23 (95.8)	≥0.25
Never drug user	47 (8.5)	508 (91.5)	
Exercise at late pregnancy			
Ever exercise	38 (7.4)	473 (92.6)	≤0.05
Never exercise	10 (14.7)	58 (85.3)	
Stress at late pregnancy			
Low stress	15 (3.9)	365 (96.1)	≤0.001
High stress	33 (16.5)	167 (83.5)	
Social support at late pregnancy			
Low support	13 (11.1)	104 (88.9)	≤0.25
High support	35 (7.6)	428 (92.4)	
Relationship status at late pregnancy			
Very satisfied	37 (7.5)	455 (92.5)	≤0.25
Not satisfied	8 (11.8)	60 (88.2)	

5.3 Moderating Analysis

In order to test the effects of sociodemographic variables such as maternal age, ethnicity, education attainment, income status and marital status as potential moderators on the relationship between behavioural and psychosocial factors measured in early pregnancy (Time 1) and depression status in late pregnancy (Time 2), hierarchical regression procedures were performed as recommended by Baron and Kenny (1986).(45)

I have reported six interactions in table 5.4. Among them, two interactions met the statistical significance; rest of the interactions did not meet the significance level, set at $p<0.05$. Results of these analyses are presented in Table 5.5 and Figures 5.1 through 5.6.

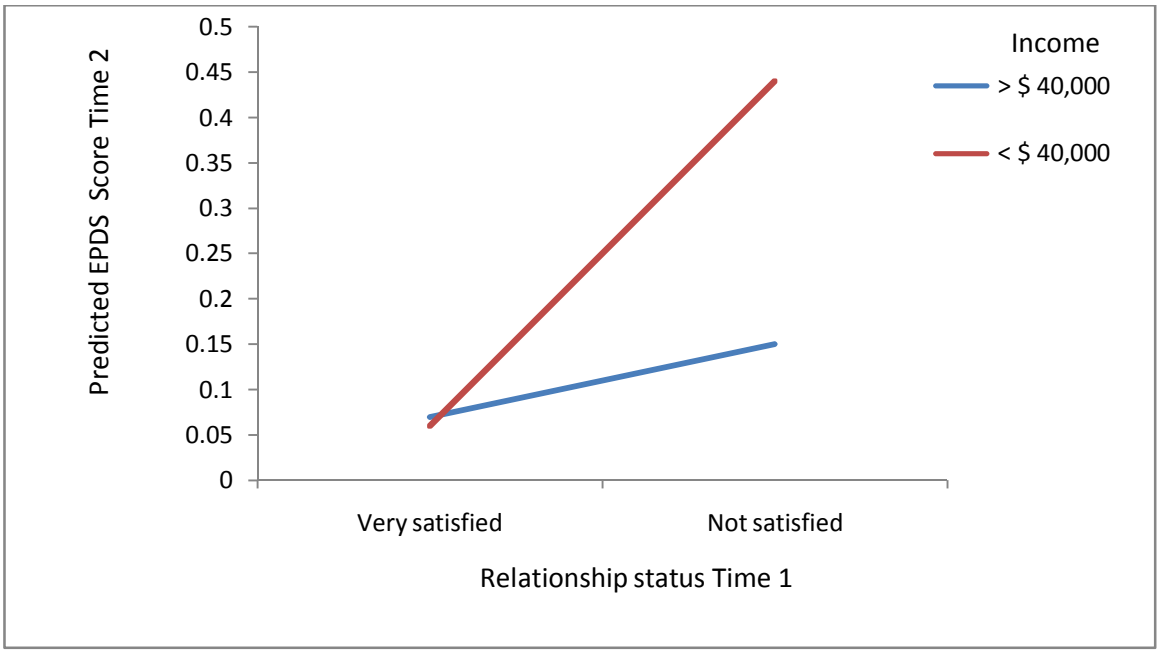
Table 5.5 Final results showing moderating effects on EPDS depression in late pregnancy (Time 2)

Variable	Multivariate Analyses			Odds Ratio (e^{β})	95% C.I.	
	Estimated β	Wald test	P value		Lower	Upper
Social support Time 1	.15	.128	≥0.05	1.16	.52	2.58
Age of Mother	.46	1.369	≥0.05	1.59	.73	3.46
Social Support Time 1 X Age of Mother	1.04	2.123	≥0.05	2.83	.70	11.48
Social Support Time 1	.19	.236	≥0.05	1.21	.56	2.58
Ethnicity	.88	3.352	≥0.05	2.41	.94	6.21
Social Support Time 1 X Ethnicity	1.12	1.898	≥0.05	3.08	.62	15.22
Relationship status Time 1	.96	3.798	≤0.05	2.61	.99	6.83
Income	-.07	.028	≥0.05	.93	.41	2.13
Relationship status Time 1 X Income	1.54	4.792	≤0.05	4.66	1.18	18.47
Relationship status Time 1	1.39	15.317	≤0.001	4.01	2.00	8.04
Ethnicity	.54	.719	≥0.05	1.72	.49	6.01
Relationship status Time 1 X Ethnicity	1.20	1.751	≥0.05	3.33	.56	19.70
Smoking status Time 1	.72	4.035	≤0.05	2.06	1.02	4.16
Income	1.16	7.306	≤0.01	3.20	1.38	7.43
Smoking status Time 1 X Income	-.46	2.281	≥0.05	.63	.35	1.15
Recreational drug status Time 1	1.11	11.587	≤0.001	3.02	1.60	5.71
Marital status	1.41	10.044	≤0.01	4.09	1.71	9.78
Recreational drug status Time 1 X Marital status	-1.62	4.642	≤0.05	.20	.05	.86

The *first* significant moderator was income; it moderated the effect of marital relationship at early pregnancy (Time 1) on depression status in late pregnancy. The results exploring predictors of depression status in late pregnancy (Time 2) showed that marital relationship status at early pregnancy (Time 1) (β =0.96; p=0.05) and income (β=0.35; p>0.05) predicted depression status in late pregnancy (Time 2). In this model, poor marital relationship at early pregnancy (Time 1) was significantly associated with depression status in late

pregnancy (Time 2), but low income status was not a significant predictor when interaction term was included. Interaction between marital relationship at early pregnancy (Time 1) and income (β=1.54; p<.05) were significant. This suggests that income moderated the relationship between marital satisfaction at early pregnancy (Time 1) and depression status in late pregnancy (Time 2).

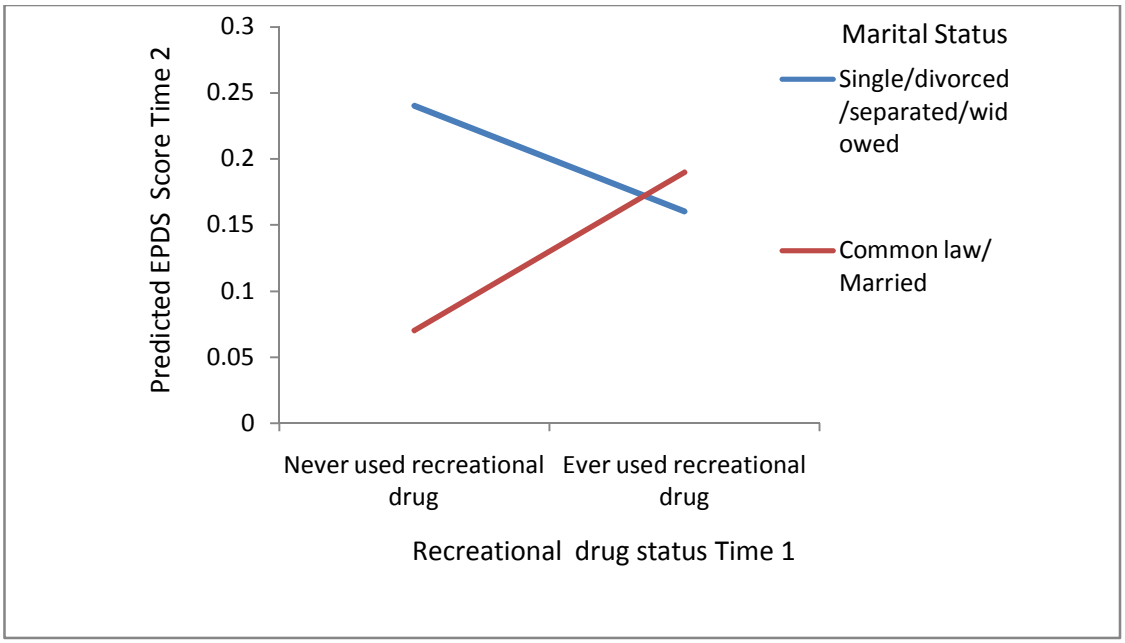
Figure 5.1 Effects of relationship status in early pregnancy on depression in late pregnancy is moderated by income levels



The *second* statistically significant moderator was marital status; it moderated the effects of recreational drug use at early pregnancy (Time 1) on depression status in late pregnancy (Time 2). Recreational drug use at early pregnancy (Time 1) X marital status was significant (β= -1.62; p<0.05) and both recreational drug use at early pregnancy (Time 1) (β=1.11; p<0.05) and marital status were still significant (β=1.41; p<0.05) after inclusion of interaction term. Interaction suggested that married or common-law partner who ever used

recreational drugs were more likely to have depression status at late pregnancy (Time 2) compared with non-married mothers.

Figure 5.2 Effects of drug use status in early pregnancy on depression in late pregnancy is moderated by marital status



There were four more interaction terms included which showed moderating effects in predicting depression status at late pregnancy (Time 2); these variables were nearly statistically significant. These four interaction terms were Social Support at early pregnancy (Time 1) X Age of Mother, Social Support at early pregnancy (Time 1) X Ethnicity, Relationship status at early pregnancy (Time 1) X Ethnicity, and Smoking status at early pregnancy (Time 1) X Income. In the interaction involving social support at early pregnancy and age of mother, analysis showed that mothers less than 25 years of age with low social support had more depressive symptoms at late pregnancy compared with mothers older than 25 years of age. In the interaction term

involving social support at early pregnancy (Time 1) and ethnicity, it was found that Aboriginal pregnant women with low social support were more likely to be depressed at late pregnancy compared with non-Aboriginal women. Ethnic background also moderated the mother's satisfaction on marital relationship at early pregnancy (Time 1). This also suggested that mothers of Aboriginal origin with poor marital satisfaction had more depressive symptoms compared with non-Aboriginal mothers. The interaction involved a behavioural factor, which was smoking status at early pregnancy (Time 1) moderated by income. Pregnant women who ever smoked in early pregnancy in low income group were more likely to be depressed in late pregnancy compared with women with higher income.

Figure 5.3 Effects of social support in early pregnancy on depression in late pregnancy is moderated by maternal age

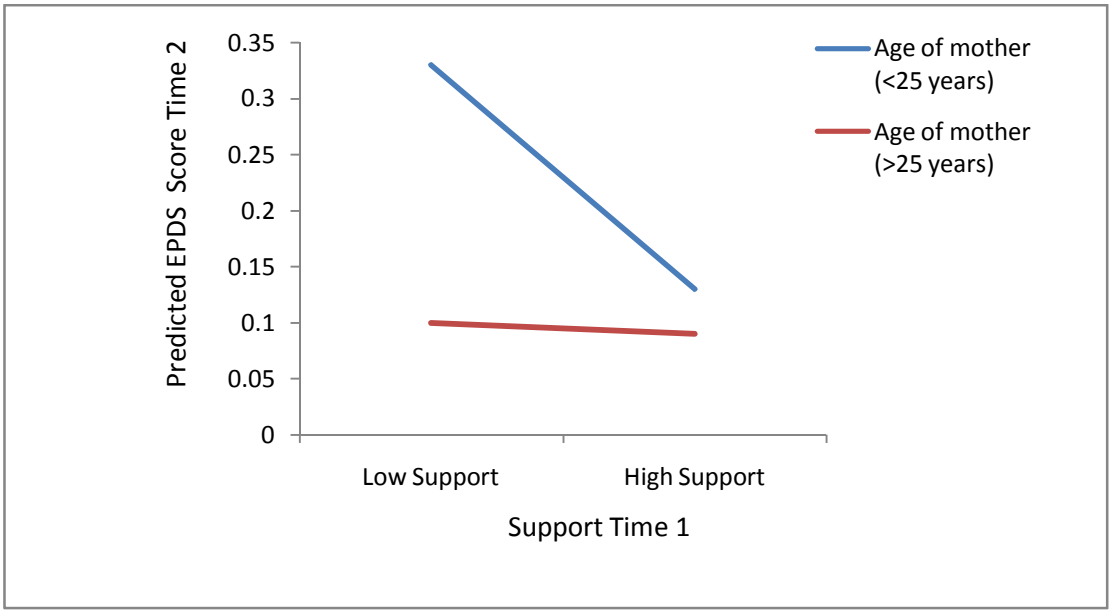


Figure 5.4 Effects of social support in early pregnancy on depression in late pregnancy is moderated by ethnicity

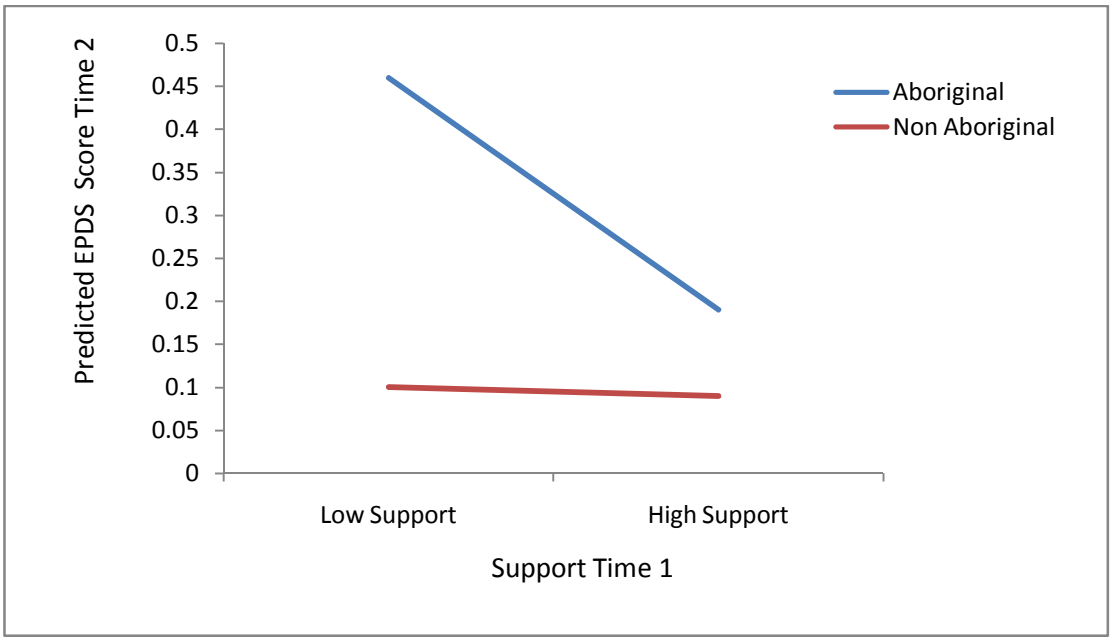


Figure 5.5 Effects of relationship status in early pregnancy on depression in late pregnancy is moderated by ethnicity

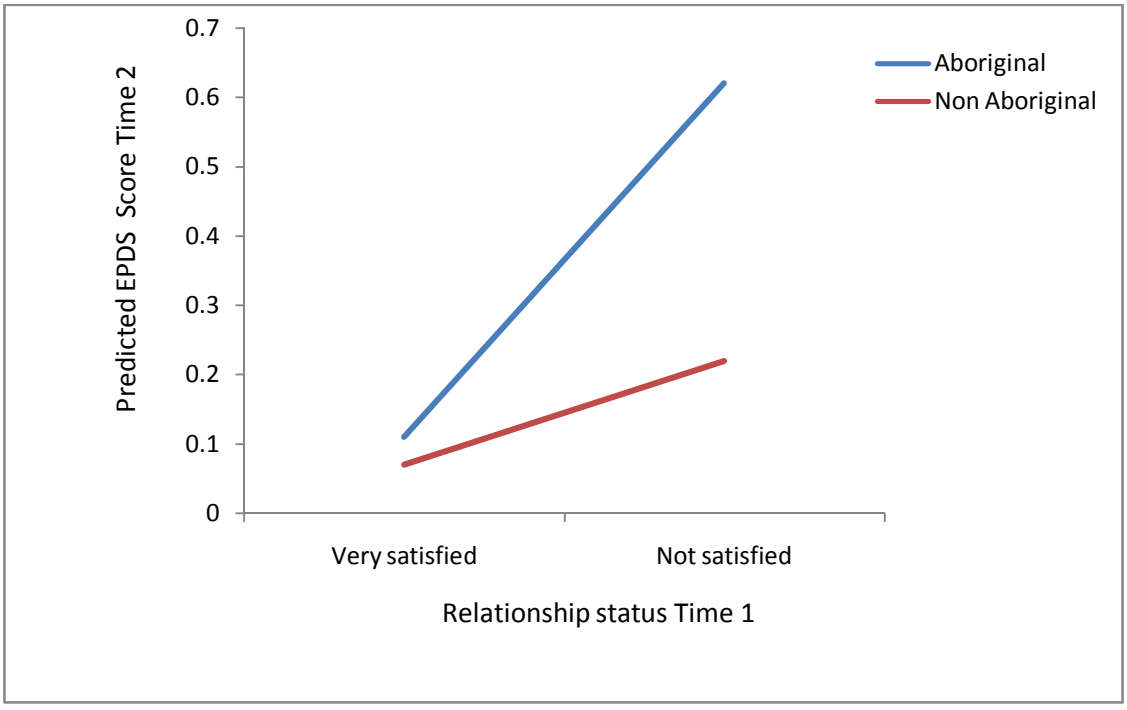
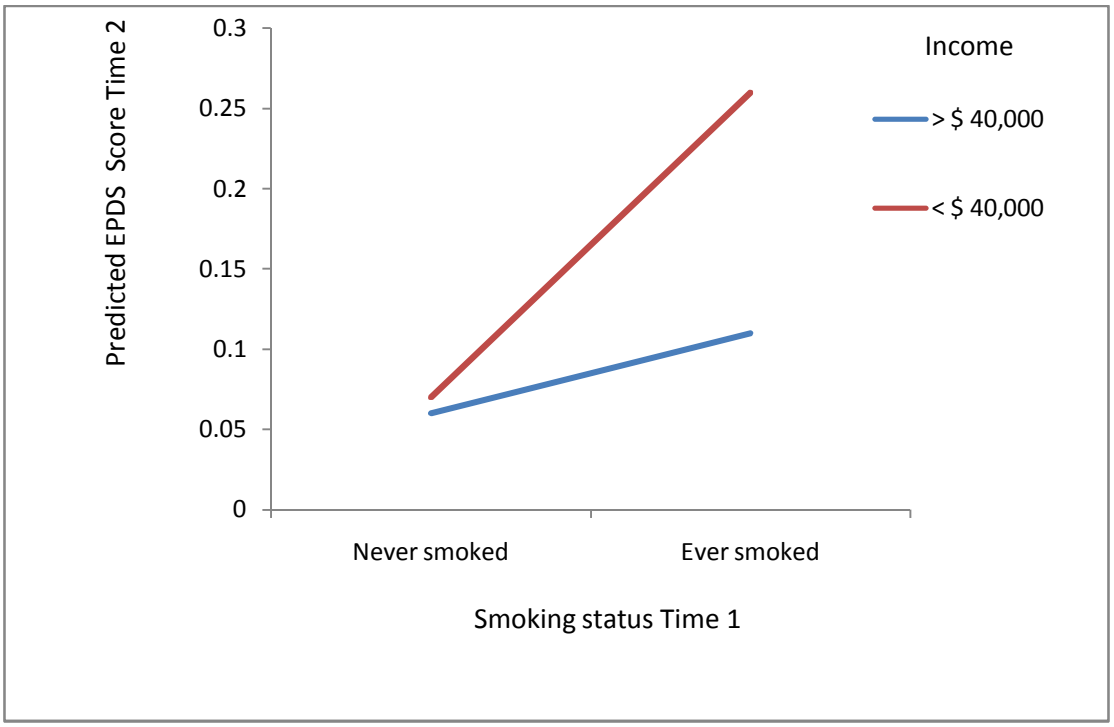


Figure 5.6 Effects of smoking status in early pregnancy on depression in late pregnancy is moderated by income

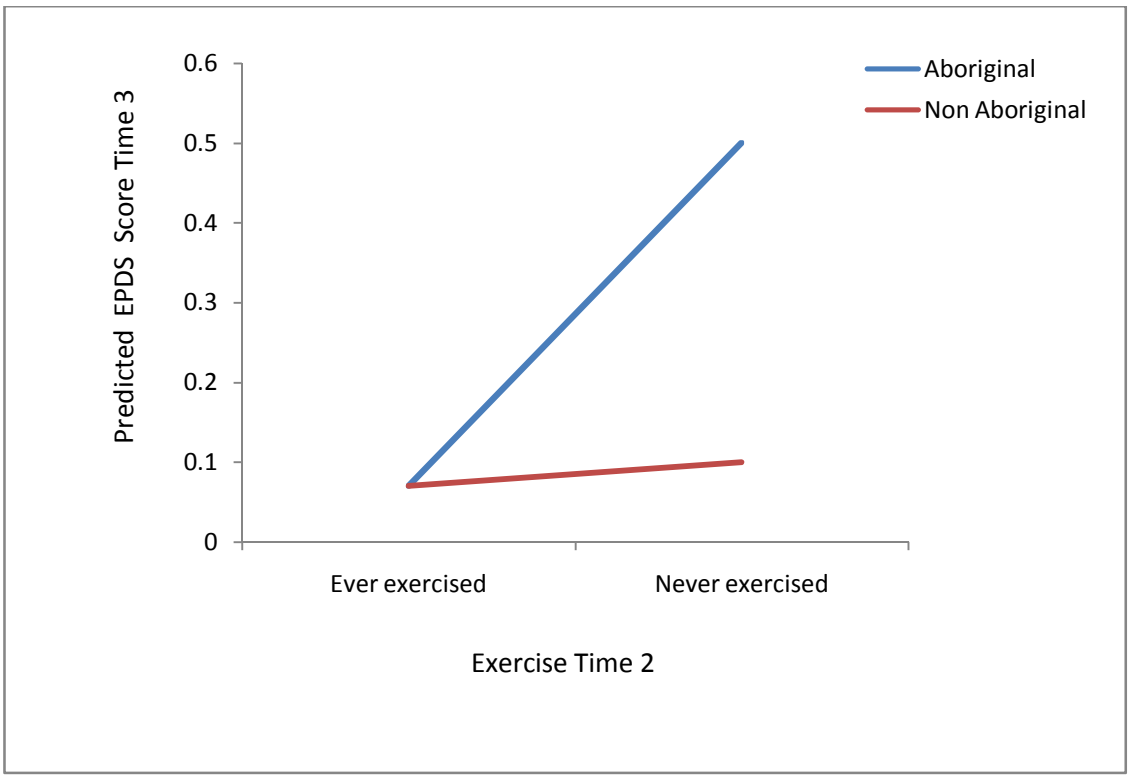


Hierarchical multiple regression analyses were also conducted for dependent variable, depression status in postpartum (Time 3). While looking for moderating effect of the sociodemographic risk factors for Time 3 postpartum depression status, only one interaction was found statistically significant. Interestingly, one protective behavioural factor, exercise status at late pregnancy (Time 2) was moderated by ethnicity in predicting depressive symptoms at postpartum (Time 3). It was found that Aboriginal mothers who reported that they never exercised during late pregnancy (Time 2) were more likely to be depressed in postpartum period compared with non Aboriginal mothers. (See Table 5.6; Figure 5.7.)

Table 5.6 Final results showing moderating effects on EPDS depression in postpartum (Time 3)

Variable	Multivariate Analyses			Odds Ratio (e^{β})	95% C.I.	
	Estimated β	Wald test	P value		Lower	Upper
Exercise Time 2	.32	.468	≥0.05	1.37	.55	3.41
Ethnicity	-.13	.027	≥0.05	.88	.20	3.86
Exercise Time 2 X Ethnicity	2.32	4.309	≤0.05	10.19	1.14	91.27

Figure 5.7 Effects of exercise status in late pregnancy on depression in postpartum is moderated by ethnicity



5.4 Mediating Analysis

Following four steps, significant mediators were identified. Table 5.7 shows the mediators that were found significant between independent variables and depression status in late pregnancy (Time 2). I have found 27 mediating pathways and they were mediated through 5 different mediators. These five mediators are stress (involved in two pathways), social support (five pathways), marital relationship status (six pathways), smoking (seven pathways), and recreational drug intake (seven pathways) at late pregnancy Time 2. (See Figure 8 through 12) I have found nine pathways, which completely mediated between independent variables and dependent variable at late pregnancy (Time 2). The rest of the pathways were partially mediated.

Table 5.7 Final results showing mediating effects on EPDS depression in late pregnancy (Time 2)

Variable	Multivariate Analyses			Odds Ratio (e^{β})	95% C.I.	
	Estimated β	Wald test	P value		Lower	Upper
Marital Status	.88	5.87	≤0.05	2.42	1.18	4.93
Stress Time 2	1.04	14.207	≤0.001	2.82	1.65	4.83
Relationship status Time 1	1.52	23.031	≤0.001	4.58	2.46	8.53
Stress Time 2	.87	8.465	≤0.01	2.39	1.33	4.28
Age of mother	.71	4.827	≤0.05	2.03	1.08	3.81
Social support Time 2	.60	4.090	≤0.05	1.83	1.02	3.28
Income	.82	8.515	≤0.01	2.28	1.31	3.96
Social support Time 2	.55	3.181	≥0.05	1.73	.95	3.15
Ethnicity	1.21	10.589	≤0.001	3.37	1.62	7.01
Social support Time 2	.59	3.917	≤0.05	1.81	1.01	3.25
Education	.87	2.705	≥0.05	2.39	.85	6.75
Social support Time 2	.67	5.205	≤0.05	1.96	1.10	3.48
Stress Time 1	1.31	20.392	≤0.001	3.71	2.10	6.56
Social support Time 2	.63	4.472	≤0.05	1.89	1.05	3.40
Age of mother	.60	2.829	≥0.05	1.83	.91	3.70
Relationship status Time 2	1.67	28.788	≤0.001	5.30	2.88	9.74
Marital Status	.27	.306	≥0.05	1.30	.51	3.33
Relationship status Time 2	1.67	27.711	≤0.001	5.31	2.85	9.88
Income	.48	2.412	≥0.05	1.62	.88	2.96
Relationship status Time 2	1.69	27.346	≤0.001	5.39	2.87	10.14
Ethnicity	1.09	7.121	≤0.01	2.99	1.34	6.69
Relationship status Time 2	1.59	25.286	≤0.001	4.89	2.64	9.09
Education	.79	1.898	≥0.05	2.19	.72	6.71
Relationship status Time 2	1.66	28.328	≤0.001	5.26	2.85	9.69
Stress Time 1	1.03	10.972	≤0.001	2.81	1.52	5.17
Relationship status Time 2	1.45	20.755	≤0.001	4.28	2.29	8.01
Age of mother	.61	3.443	≥0.05	1.83	.97	3.48
Smoking status Time 2	1.02	12.324	≤0.001	2.77	1.57	4.90
Marital Status	.66	3.104	≥0.05	1.93	.93	4.01
Smoking status Time 2	1.00	11.534	≤0.001	2.71	1.53	4.83
Income	.68	5.457	≤0.05	1.97	1.12	3.47
Smoking status Time 2	1.02	11.579	≤0.001	2.77	1.54	4.98
Ethnicity	1.07	7.815	≤0.05	2.91	1.38	6.15
Smoking status Time 2	.99	11.403	≤0.001	2.69	1.51	4.77
Education	.30	.294	≥0.05	1.35	.45	4.03
Smoking status Time 2	1.06	12.664	≤0.001	2.90	1.61	5.21
Stress Time 1	1.25	18.175	≤0.001	3.49	1.96	6.19
Smoking status Time 2	.98	11.245	≤0.001	2.66	1.50	4.72
Relationship status Time 1	1.66	28.008	≤0.001	5.25	2.84	9.70
Smoking status Time 2	.93	8.750	≤0.01	2.54	1.37	4.71
Age of mother	.69	4.487	≤0.05	1.99	1.05	3.76
Drug taking status Time 2	1.42	10.566	≤0.001	4.14	1.76	9.76
Marital status	.88	5.855	≤0.05	2.42	1.18	4.93
Drug taking status Time 2	1.48	11.478	≤0.001	4.38	1.86	10.28

Income	.79	7.747	≤0.01	2.20	1.26	3.84
Drug taking status Time 2	1.39	9.929	≤0.01	4.02	1.69	9.54
Ethnicity	1.13	8.814	≤0.01	3.11	1.47	6.58
Drug taking status Time 2	1.33	8.902	≤0.01	3.79	1.58	9.08
Education	.62	1.246	≥0.05	1.86	.63	5.54
Drug taking status Time 2	1.44	10.723	≤0.001	4.24	1.79	10.05
Stress Time 1	1.29	19.451	≤0.001	3.63	2.05	6.43
Drug taking status Time 2	1.40	9.922	≤0.01	4.07	1.70	9.76
Relationship status Time 1	1.69	28.804	≤0.001	5.43	2.93	10.07
Drug taking status Time 2	1.59	11.980	≤0.001	4.90	1.99	12.05

Figure 5.8 Effects of antecedent risk factors in early pregnancy on depression in late pregnancy is mediated by stress at late pregnancy

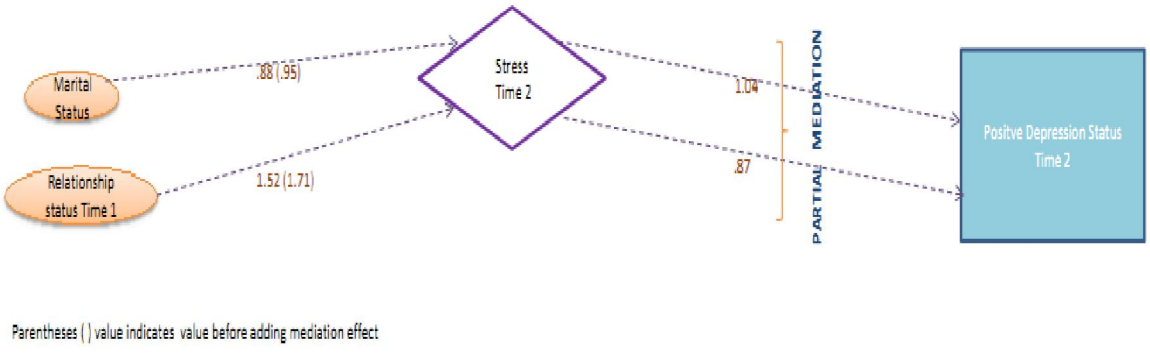
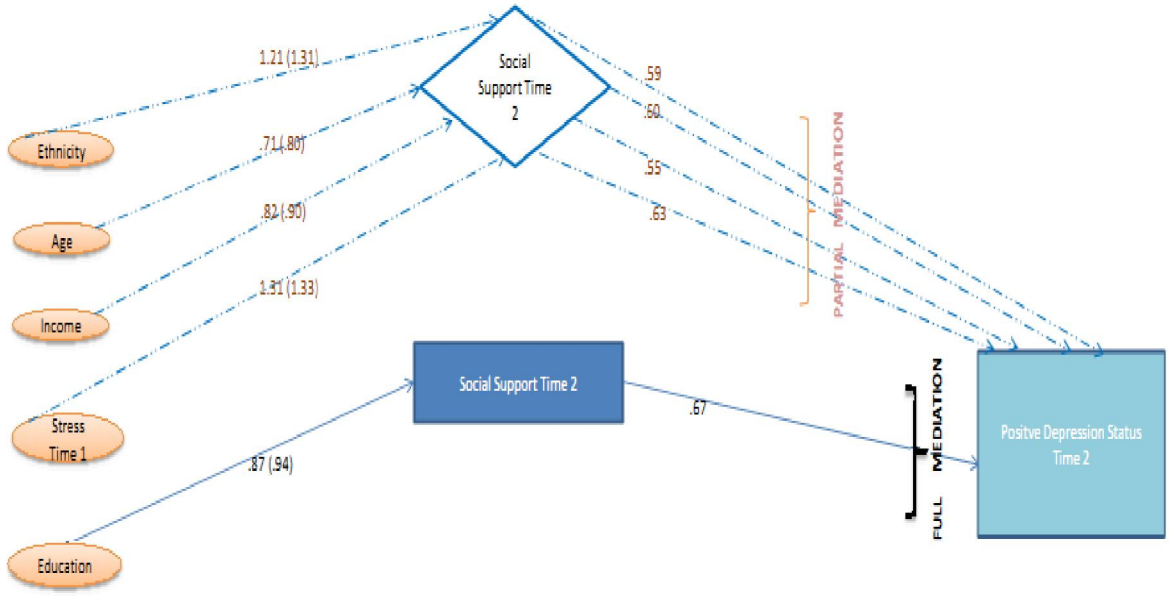
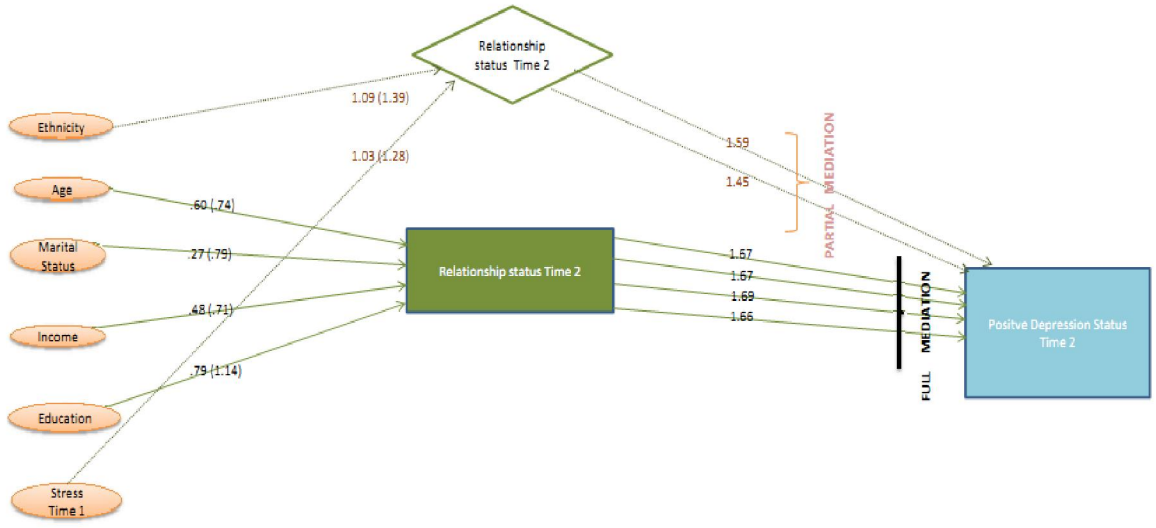


Figure 5.9 Effects of antecedent risk factors in early pregnancy on depression status in late pregnancy is mediated by social support at late pregnancy



Parentheses ( ) value indicates value before adding mediation effect

Figure 5.10 Effects of antecedent risk factors in early pregnancy on depression status in late pregnancy is mediated by partner relationship status at late pregnancy



Parentheses ( ) value indicates value before adding mediation effect

Figure 5.11 Effects of antecedent risk factors in early pregnancy on depression status in late pregnancy is mediated by smoking status at late pregnancy

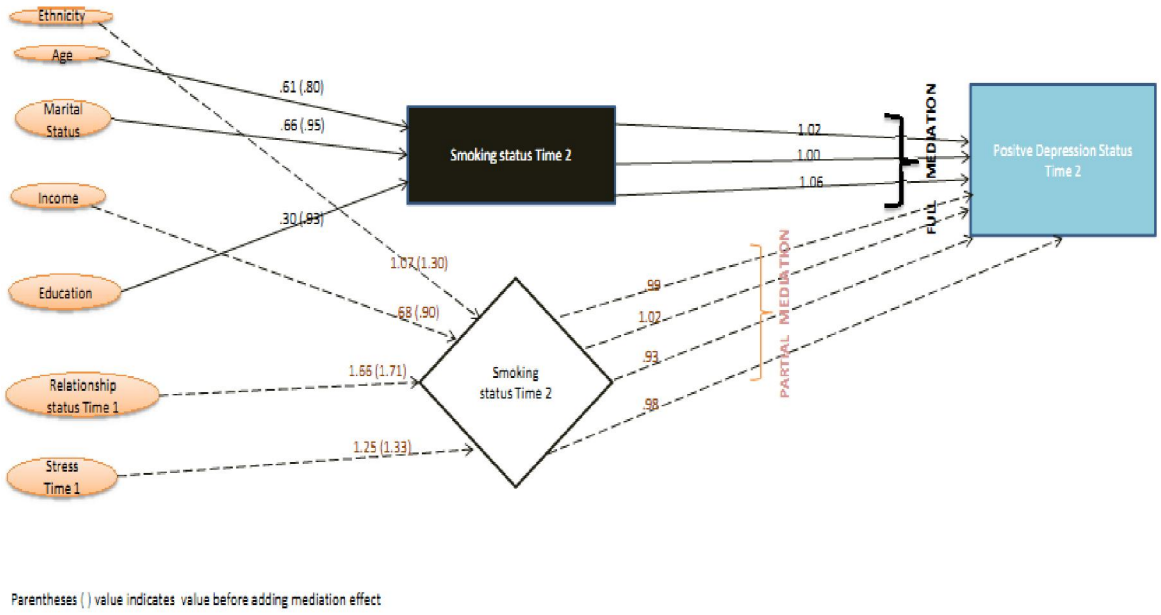
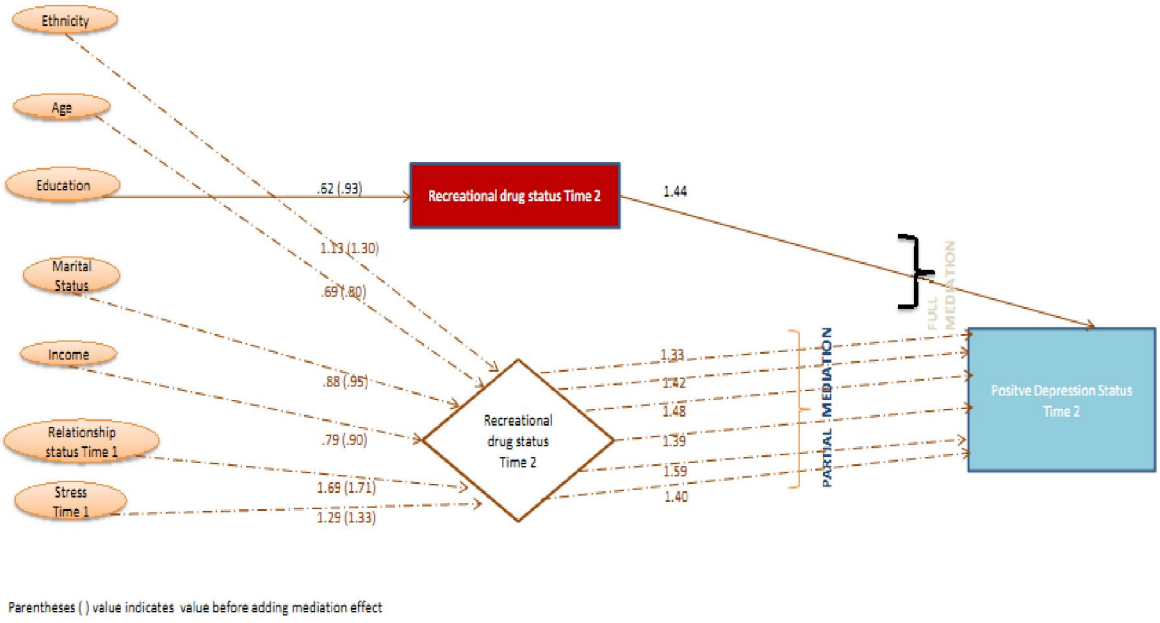


Figure 5.12 Effects of antecedent risk factors in early pregnancy on depression status in late pregnancy is mediated by drug use status at late pregnancy



In mediating analysis for Time 3 postpartum depression status, as I mentioned earlier, potential mediators were psychosocial and behavioural risk factors such as social support,

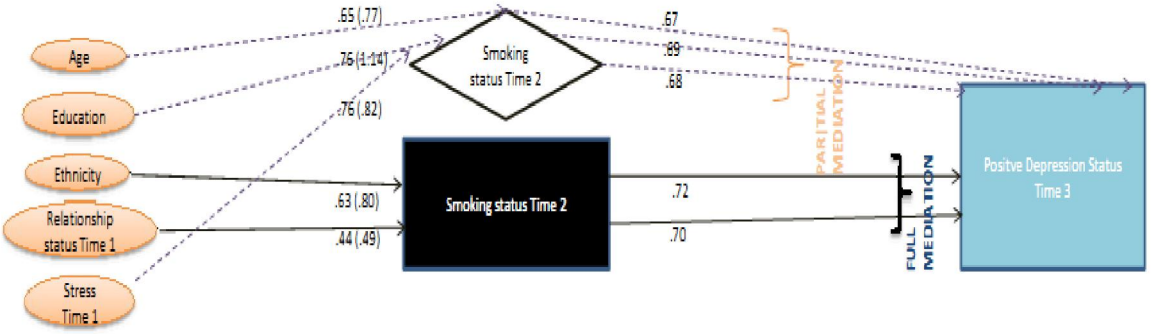
stress, and satisfaction with relationship status, smoking, alcohol, recreational drug intake and exercise status measured at late pregnancy (Time 2). Using a four-step process as described earlier, significant mediators were identified. Table 5.8 shows the results in the final steps identifying mediators that were significant between independent variables and depression status in postpartum (Time 3).

I have found 5 mediating pathways; they mediated associations through one mediator variable, which was smoking status at Time 2 late pregnancy. (See Figure 5.13) I have found two pathways indicating full mediating effect and three pathways indicating partial mediating effect between independent variables and dependent variable at postpartum (Time 3).

Table 5.8 Final results showing mediating effects on EPDS depression in postpartum (Time 3)

Variable	Multivariate Analyses			Odds Ratio (e^{β})	95% C.I.	
	Estimated β	Wald test	P value		Lower	Upper
Age of Mother	.65	3.152	≥0.05	1.91	.94	3.90
Smoking Status Time 2	.69	4.159	≤0.05	1.99	1.03	3.88
Ethnicity	.63	1.686	≥0.05	1.88	.73	4.84
Smoking status Time 2	.72	4.534	≤0.05	2.05	1.06	3.99
Education	.76	1.498	≥0.05	2.13	.63	7.19
Smoking status Time 2	.67	.351	≤0.05	1.96	.99	3.91
Stress Time 1	.76	5.974	≤0.05	2.13	1.16	3.90
Smoking status Time 2	.68	.337	≤0.05	1.98	1.02	3.83
Relationship status Time 1	.44	1.123	≥0.05	1.56	.69	3.52
Smoking status Time 2	.70	3.918	≤0.05	2.00	1.01	3.99

Figure 5.13 Effects of antecedent risk factors in early pregnancy on depression status in postpartum is mediated by smoking status at late pregnancy

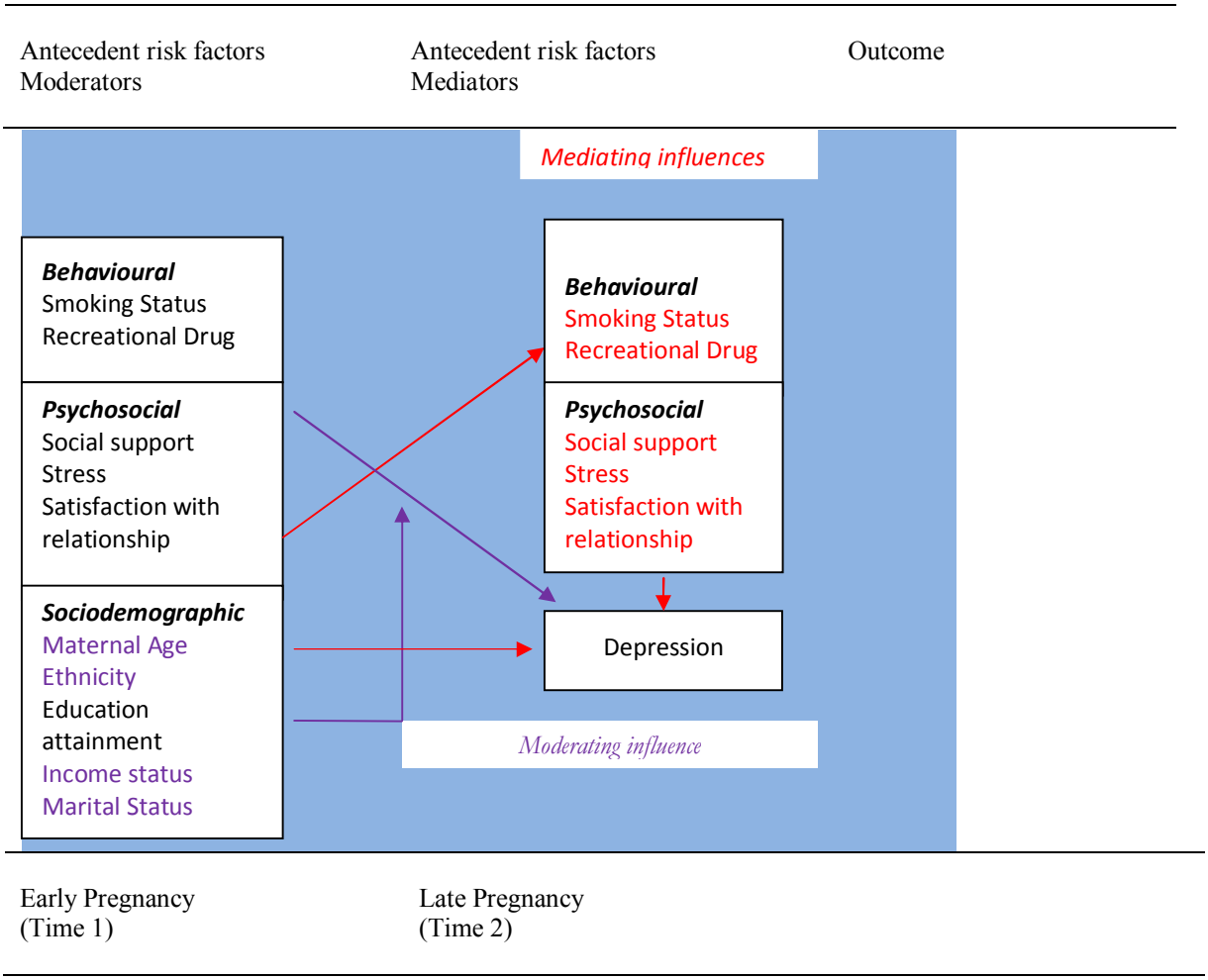


5.5 Moderating and Mediating Analysis for Late Pregnancy and Postpartum

This section presents the results addressing the third research questions (Question 3a and Question 3b) as how moderators and mediators simultaneously predict depressive status in the subsequent period either in late pregnancy or in the postpartum period.

In moderating analysis for depression status at late pregnancy, four moderators were found. They are - maternal age, income, ethnicity, and marital status. In mediating analysis for depression status at late pregnancy, five mediators were found significant: stress at late pregnancy (Time 2), social support at late pregnancy (Time 2), partner relationship status at late pregnancy (Time 2), smoking status at late pregnancy (Time 2), and recreational drug use status at late pregnancy (Time 2). (See Figure 5.14)

Figure 5.14 Antecedent risk factors simultaneously moderating and mediating relationship with depression in late pregnancy

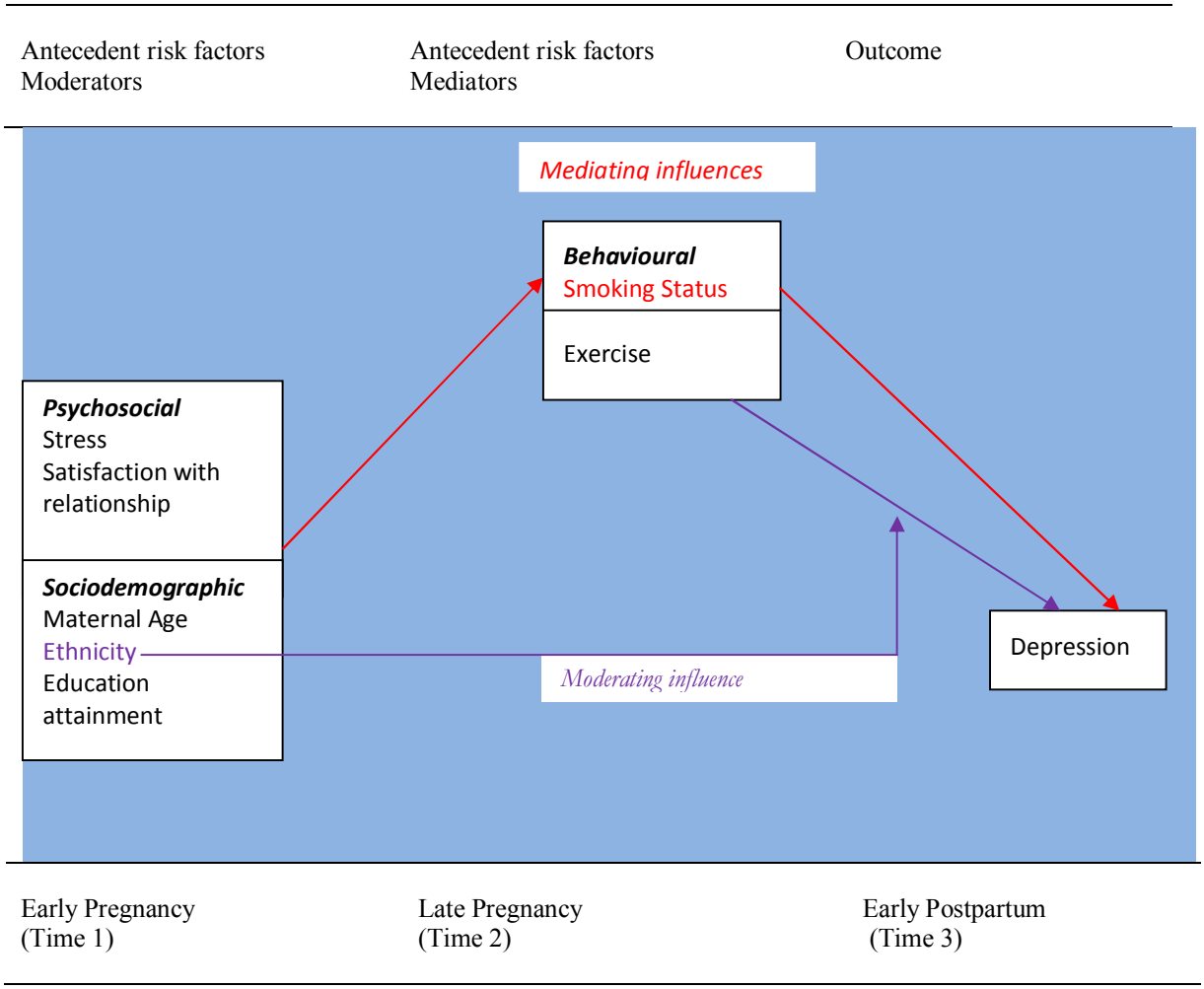


In moderating analysis for late pregnancy, low income with poor marital relationship (β=1.54; $p<0.05$) and married or common law partner women who used recreational drug (β= -1.62; $p<0.05$) were more likely to be depressed. Young and Aboriginal mother with low social support were also nearly significant to occurring depression in late pregnancy. In mediating analysis for late pregnancy, mediators such as psychosocial factors stress, social support, marital satisfaction and behavioural factors smoking and recreational drug use measured in late

pregnancy exerted partial or full mediating effect for depressive symptoms in women in late pregnancy.

For postpartum depression (Time 3), only one moderator and one mediator was found significant. The only significant moderator was ethnicity and the only significant mediator was smoking status at late pregnancy. (See Figure 5.15)

Figure 5.15 Antecedent risk factors simultaneously moderating and mediating relationship with depression in early postpartum period



In moderating analysis for postpartum, Aboriginal women who never exercise in late pregnancy were found depressed at postpartum period compared with non Aboriginal mothers. In mediating analysis for postpartum, smoking at late pregnancy exerted full mediating effect for ethnicity and marital satisfaction pathways and partial mediating effect for age, education and stress pathways in predicting depression in postpartum period among mothers.

CHAPTER 6

DISCUSSION AND CONCLUSION

This thesis examines the moderating and mediating role of the antecedent risk factors for depression status at late pregnancy and postpartum period. Previous studies have found that one of the most important risk factors for depression in pregnancy and postpartum is history of depression from previous pregnancy or previous episodes of depressive symptoms not related to pregnancy. As mentioned earlier, history of depression was not included in the analysis as this is not a modifiable factor in relation to the current pregnancy, nor does it qualify as a mediator. I was more interested in examining whether sociodemographic, psychosocial, or behavioural factors commonly reported in the depression literature are moderating or mediating the relationship with subsequent depression symptoms. History of depression would be an important factor if I had analysed the data that identifies the potential risk factors for antenatal and postpartum depression. However, taking advantage of the longitudinal study design of the Feelings in Pregnancy study, I wanted to examine these moderating and mediating relationships, specifically temporal precedence of the sociodemographic, psychosocial, and behavioural risk factors in relation to depression outcomes.

6.1 Summary of the Study Findings

In my hypotheses, as I mentioned earlier, I chose sociodemographic factors as potential moderators as these are distal antecedent risk factors. Psychosocial and behavioural factors

were chosen as mediators as they are proximal determinants for depression status during pregnancy or postpartum.

In moderating analysis for depression status at late pregnancy, there are four moderators which were statistically significant or nearly significant. They were maternal age, income, ethnicity, and marital status. In mediating analysis for depression status at late pregnancy, there are five mediators which were significant: stress at late pregnancy (Time 2), social support at late pregnancy (Time 2), partner relationship status at late pregnancy (Time 2), smoking status at late pregnancy (Time 2), and recreational drug use status at late pregnancy (Time 2).

In moderating analysis, income and marital status significantly moderated the relationship for depressive symptoms at late pregnancy. The other two sociodemographic factors maternal age and ethnicity were nearly significant. This study found that poor marital satisfaction in low income mothers had more depressive symptoms in late pregnancy. These finding are consistent with other literature.(99,100) Research has revealed that lower education, income, and social support are factors, which predict decline in marital satisfaction during this time.(99,100) Marital satisfaction was found in the literature as an important predictor in the transition to parenthood and for marital stability,(101) personal well-being,(52) parental involvement,(102) and infant attachment and security.(121) Therefore, it is possible that low income mothers, poor marital relationship with their partners exacerbates the risk for depression during pregnancy.

It was also found that mothers who were in married or common law relationships and used recreational drugs in early pregnancy were more likely to report depressive symptoms in

late pregnancy compared with those who reported they were single and used drugs in early pregnancy. Being married or having a common law partner is usually considered a protective factor for risk for depression. However, other studies have also found that intimate partner relationship is an important protective or buffering factor for mitigating risk for depression. It is likely possible that pregnant women whose intimate partners use recreational drugs to be more influenced by their partners' behaviour.(122) I have looked further into recreational drug use at early pregnancy whether it was related to relationship status at early pregnancy in predicting depression at late pregnancy. I found a significant association between relationship status at early pregnancy and depression at late pregnancy in the 'ever drug use' group. Therefore, it showed that poor partner relationship satisfaction at early pregnancy, on top of being married or having a common law partner, was associated with increased recreational drug use at early pregnancy, and had predicted depression in late pregnancy in particular. Another possible explanation is that recreational drugs were used to counteract the depression as a result of poor relationship status (i.e., 'self medication'). I suggest these findings provide important information for targeted program or creating awareness to prevent substance use in the pregnancy.

This study reported other important moderating effects, which were nearly statistically significant. Aboriginal women with poor marital relationship or low social support were more likely to have depressive symptoms during late pregnancy. While satisfactory marital relationship and having a high social support are both important protective factors for depression among women, Aboriginal mothers in the mainstream (non Aboriginal) society experiences challenges that non Aboriginal mothers likely do not experience. Marginalized

population such as Aboriginal women, other visible minority groups, or immigrant women are vulnerable groups of people who usually have low resources and opportunities. Marginalized groups of women such as those mentioned here usually occupy lower socio-economic position in the society. Therefore, poor socio-economic position could explain further why Aboriginal women had more mental health problem such as depression in pregnancy.

Another moderating effect showed that young mothers were more likely to be depressed if they lack social support. Young maternal age or Aboriginal status with low social support, low income or Aboriginal status with poor partner relationship at early pregnancy, low income with ever cigarette smoking at early pregnancy were all consistent with the previous literature for predicting depression. Targeted interventions should be developed addressing these vulnerable groups.

Considering mediating analysis for Time 2 late pregnancy, there were five mediators, which either fully or partially mediated the relationships with depression in late pregnancy. Among them, three were psychosocial risk factors and others were behavioural risk factors. *First*, stress at late pregnancy was a mediator in the relationships predicting depression status in late pregnancy. The effects of marital status and relationship status in early pregnancy on depression symptoms in late pregnancy were partially mediated through stress at late pregnancy. Single mothers and those who were in unsatisfactory marital relationships are more likely to experience stress. Single mothers may lack support which is crucial for mental wellbeing especially in pregnancy. Single mothers may require extra efforts to meet their daily needs which ultimately put them in excess stress and this stress might be mediated in experiencing depression in pregnancy. The *second* mediator, social support at late pregnancy,

completely mediated the relationship between antecedent factor, education, and depressive symptoms in late pregnancy. In other words, mothers with less educational attainment were likely to have a lack for social support, which in turn contributed to having more depressive symptoms in late pregnancy. Social support also partially mediated the effects of age, ethnicity, income, and stress at early pregnancy on depression status in late pregnancy. This means younger maternal age, Aboriginal mothers, low income, and experiencing high stress in early pregnancy are likely to experience low social support, which ultimately may have contributed to depression symptoms in late pregnancy. The *third* mediator was relationship status at late pregnancy. The effects of young maternal age, single marital status, low income and low education level were fully mediated (whereas effects of ethnicity and stress at early pregnancy were partially mediated) by relationship status at late pregnancy on predicting depression symptoms in late pregnancy.

Stress, social support, relationship status have complex relationships with depression as literature has suggested. According to the stress process theory,(84) social support is recognized as a primary mediating resource. According to this theory, social support mediates social stress for symptomatic manifestation of stress, which is psychological, emotional, or physical outcomes. In addition, partner support may indirectly mediate the stress by curbing the extant and intensity of stress outcomes.(123) This mediating analysis is in line with this theory. It is therefore possible, besides social support, marital satisfaction with the intimate partner can mediate the stressors (young age, single, or separated mother, low income or low educational attainment) for symptomatic psychological manifestation of depression during pregnancy.

The *fourth and fifth* mediators were behavioural risk factors smoking status at late pregnancy and drug status at late pregnancy. The effects of young maternal age, single marital status and low education were fully mediated (whereas the effects of ethnicity, income, relationship status and stress in early pregnancy were partially mediated) through smoking status at late pregnancy in predicting depressive symptoms in late pregnancy. Low education, not being married and low income were found to predict continued smoking among pregnant mothers;(110,124,125) but no study was found that had reported mediating relationship between antecedent risk factors and depression in pregnancy where smoking status was considered as a mediator. Also, the causality, whether smoking risk precedes or follows depression status is still unresolved.(33,110) Smoking in late pregnancy and depression in late pregnancy could be bidirectional; but it is evident that antecedent factors such as single marital status, poor relationship status or stress in the early pregnancy could influence both smoking and depression in the late pregnancy. Therefore, the findings from this mediating relationship will guide to develop maternal smoking interventions for the targeted group.

In recreational drug use at late pregnancy as a mediator, the effects of low education were fully mediated (whereas young maternal age, single marital status, Aboriginal ethnicity, low income, poor marital relationship and stress in early pregnancy partially mediated) in predicting depressive symptoms in late pregnancy. Literature suggested smoking, alcohol and substance use as negative coping strategies to manage the stressors.(103) It is therefore possible that these negative coping strategies can mediate between stressors (young age, single, or separated marital status, low income, low education, Aboriginal status, poor marital satisfaction, or social stress) for depression during pregnancy. Usually, women tend to reduce

the use of substance after learning about their pregnancy(32) but if mothers were depressed or had negative attitude towards pregnancy, they might use recreational drugs as well as smoking and alcohol.(32) Furthermore, the relationship of drug use in pregnancy and depression in pregnancy could be stronger if mothers live with multiple stressors such as low income or poor marital relationship. Therefore, this mediating relationship among antecedent risk factors, recreation drug use and depression in late pregnancy provides evidence for the groups that should be targeted for preventive intervention who are known to be disadvantaged because of their sociodemographic profiles. It is also noteworthy to mention that I had not found moderating or mediating relationship for alcohol consumption and depression in late pregnancy. It is possible that the mothers were aware of about the adverse effect of alcohol consumption on the fetus and less number of mothers consumed alcohol during pregnancy.

In moderating analysis for postpartum period (Time 3), only one sociodemographic factor, 'ethnicity', moderated the relationship of exercise status at postpartum in predicting depressive symptoms. It showed that Aboriginal mother were more likely to be depressed if they did not exercise. Depressive status was not different among Non-aboriginal women whether they exercise or not. Non-aboriginal mothers were probably protected from depression in general if they have adequate knowledge of leading a healthy lifestyle or they live in a neighbourhood which promotes healthy lifestyle. Therefore, along with socio-economic disadvantage, the neighbourhood or the context where people live could be an important factor.(126) It is possible Aboriginal mother those who had a lack of resource or knowledge, or living in a place which does not promote healthy lifestyle actually increased depression in the

pregnancy when there was no scope or motivation for exercise which is believed to be a protective factor.

Mediating analysis for Time 3 postpartum depression symptoms, smoking status at late pregnancy, is the only mediator, which either fully or partially mediated the relationships. These risk factors completely mediated the relationship between antecedent factors ethnicity and relationship status at early pregnancy for depressive symptoms late pregnancy. In other words, mothers of Aboriginal origin and poor marital satisfaction were likely to use tobacco, which ultimately contributed to having more depressive symptoms in late pregnancy. Smoking status at late pregnancy (Time 2) also partially mediated for age, education and stress at early pregnancy for depression status in late pregnancy, which means younger maternal age, low educational attainment, and feeling of high stress in early pregnancy had used more tobacco which ultimately contributed to having depression symptoms in late pregnancy. Besides, using smoking as a coping strategy for managing stress and depression, it is also possible that it could be harder for mothers to quit smoking even they are pregnant. There could be neuro-biological mechanism persisted for nicotine addiction that makes it difficult for the mothers to quit smoking during pregnancy.(127)

In considering for mediating analysis, Baron and Kenny(45) suggested that there must be a strong causal relationship present between predictor variable and mediating variable, as well as mediating variable to criterion variable. In searching for a causal relationship, Bradford Hill shared his nine viewpoints which is exclusively cited in epidemiological literature as Bradford-Hill criteria for inferring causation. However, Hill himself was conservative about declaring any relationship as causal, based upon nine viewpoints mentioning, "None of nine

viewpoints can bring indisputable evidence for or against the cause-and-effect hypothesis and none can be required as a sine qua non".(128) Rather, Hill suggested to make up our minds to find whether there are other explanations which could answer equally or more likely than cause and effect relationship. Kraemer et al. also mentioned that it is not possible to confer causality from a non-experimental data.(129) Therefore, I am still cautious to declaring my study results as causal while examining the mediating role in a longitudinal study which provides the advantage of temporal precedence of antecedent risk factors in relation to mediator and outcome variable.

6.2 Strengths and Limitations

This was a longitudinal cohort study and used face to face interviews for collecting the data. Therefore, these findings provide stronger evidence than cross-sectional studies. Also, measuring depression status using EPDS scale is well known in the major depression and postpartum depression studies. The strength of this scale as I mentioned earlier, is that it does not include the somatic symptoms of depression, which could be masked by somatic symptoms of the pregnancy (loss of appetite, nausea, feeling tired, and headache).(120) A number of studies had used a cut-off score greater than or equal to 10 for minor depression and greater than or equal to 13 for major depression.(26,69,130-132) In this study, I had decided the cut-off score on 12 or more to determine positive depressive symptoms.(120) In this study, I chose logistic regression for examining moderating and mediating relationship. The advantage of using logistic regression is well known for robustness, flexibility, easy and meaningful interpretation, less number of categories in explanatory variables (usually two or three

categories) and when no assumption are made regarding distribution of explanatory variables.(133) However, chance of overestimation of the effect size could not be eliminated as logistic regression is known for classification error.(133)

Among the study limitations, the first one would be the participant characteristics of the study. The women were more likely married or having common law partner, well educated, and higher income compared with women in general population.(24) Therefore, moderating and mediating effects should cautiously be generalised. The second limitation is that multiple methods for confirming the depression as a diagnosis were not used.(134) The EPDS is a reliable tool for screening out of depressive symptoms, still it is not an alternative to clinical diagnosis. Third, mediating relationship between Time 1 early pregnancy antecedent risk factors and Time 2 late pregnancy depression status, late pregnancy psychosocial and behavioural factors were considered as the mediating variables. However, in real world it is possible that depression status which I consider as outcome could also be the mediators for these mediating analysis. I did not check the possibility of these reverse causation possibility as I wanted to focus on depression status in late pregnancy as an outcome variable. The fourth limitation was about timing of collecting data especially in postpartum period. It is possible that data were collected in some women before they suffer from postpartum depression or had never reported to us once they were depressed.

6.3 Conclusions and Implications

Nevertheless, despite of these limitations, there are important contributions in this study. Future researcher can use multiple methods for confirming depression status. Also,

examining reverse causation would be also interesting whether depression status could mediate for psychosocial or behavioural factors. The current study provides an empirical framework for the researchers through testing the mediating and moderating effects of antecedent risk factors for subsequent depression over a period. Although antenatal depression had higher prevalence, there was less amount of research found. This thesis has reported significant amount of information on antecedent risk factors that moderate or mediate for antenatal depression. In consideration of the probable mechanisms, these findings may help the policymakers to design effective community interventions aimed at improving risk factors in the community with depression during pregnancy and postpartum. For example, behavioural modification strategies should be implemented for smoking, alcohol or drug use. Counselling should be offered to the mothers if they find trouble to quit smoking. If possible, smoking cessation program should be developed for pregnant women. Again, the study findings also suggest screening pregnant women universally and should be directed to appropriate care and counselling. Health practitioners should be trained to detect the antenatal and postnatal depression as the symptoms of pregnancy could mask the symptoms of depression. Also, health practitioners should be aware of and recognise about the stigma and risk behaviours associated with antenatal and postnatal depression. Early identification and treatment by the practitioners will prevent mothers from further deterioration of the depressive symptoms and will rescue the offspring from the adverse effect of maternal depression. Knowledge translation and dissemination activities should be conducted among the mothers, the community, health practitioners, and all related stakeholders. Thus, creating awareness, regular screening and targeted intervention may help reducing the severity of the symptoms and incidence of

depression during pregnancy and postpartum as well as preventing the adverse consequences on the health of the mother and her child .

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Appendix A

Edinburgh Postnatal Depression Scale (EPDS)

1. I have been able to laugh and see the funny side of things:	
As much as I always could	0
Not quite so much now	1
Definitely not so much now	2
Not at all	3
2. I have looked forward with enjoyment to things:	
As much as I ever did	0
Rather less than I used to	1
Definitely less than I used to	2
Hardly at all	3
3. I have blamed myself unnecessarily when things went wrong:	
Yes, most of the time	3
Yes, some of the time	2
Not very often	1
No, never	0
4. I have been anxious or worried for no good reason:	
No, not at all	0
Hardly ever	1
Yes, sometimes	2
Yes, very often	3
5. I have felt scared or panicky for no very good reason:	
Yes, quite a lot	3
Yes, sometimes	2
No, not much	1
No, not at all	0
6. Things have been getting on top of me:	
Yes, most of the time I haven't been able to cope at all	3
Yes, sometimes I haven't been coping as well as usual	2
No, most of the time I have coped quite well	1
No, I have been coping as well as ever	0
7. I have been so unhappy that I have had difficulty sleeping:	
Yes, most of the time	3
Yes, sometimes	2
Not very often	1
No, not at all	0

8. I have felt sad or miserable:

Yes, most of the time	3
Yes, quite often	2
Not very often	1
No, not at all	0

9. I have been so unhappy that I have been crying:

Yes, most of the time	3
Yes, quite often	2
Only occasionally	1
No, never	0

10. The thought of harming myself has occurred to me:

Yes, quite often	3
Sometimes	2
Hardly ever	1
Never	0

TOTAL SCORE_____